THURSDAY, APRIL 30, 1885

THE FOSSIL MAMMALIA IN THE BRITISH MUSEUM

Catalogue of the Fossil Mammalia in the British Museum (*Natural History*). Part I., containing the Orders Primates, Chiroptera, Insectivora, Carnivora, and Rodentia. By Richard Lydekker, B.A., F.G.S., &c. (London: Printed by order of the Trustees, 1885).

IN the above-named volume we welcome another contribution to the series of descriptive catalogues of the Natural History Section of the British Museum, which, initiated by the late indefatigable Keeper of the Zoological Department, Dr. J. E. Gray, have been energetically extended under the direction of his eminent successor, Dr. Günther, himself the author of the greatest of them all, the now classical "Catalogue of Fishes."

Unlike that valuable work, however, and the subsequently published catalogues of Chiroptera, of Birds, and of Batrachia, the volume before us does not conceal, under the modest title of "Catalogue," a systematic treatise on the orders dealt with, for it includes even less than its title implies, dealing only, as a rule, with the specimens of fossil Mammalia exhibited in the Museum galleries. We regret that this is so; an excellent opportunity has been lost by the author of bringing out a monograph, complete to date, of all the species of fossil mammals known—a work urgently needed not only by the student of palæontology, but by biologists in general, whose successful study of existing animals depends so largely on their knowledge of extinct forms.

Although the subjects of this work belong as truly to the zoological series as any of the groups of animals treated of in the catalogues of the Zoological Department above referred to, yet, as their remains which form the material on which it is founded are conventionally termed "fossils," the volume is prefaced by the learned head of the Department of Geology, Dr. Henry Woodward. This is, no doubt, as it ought to be, for Dr. Woodward is not only a distinguished palæontologist but a zoologist also; but the circumstance points to the uncomfortable fact that the collections on which it is based occupy a part of the house different from that of their nearest relations—a condition which, however convenient for departmental reasons, is none the less to be deplored as contrary to the principles which should govern the arrangement of a collection intended for instruction, and misleading to the general non-scientific visitor, who is necessarily led by such an arrangement to regard the animals, whose remains are presented thus to his view, as creatures of a parentage altogether distinct from that of existing species. We are confident that our opinions on this subject are shared by the able director of the Museum, whose arrangement of the specimens in the Hunterian Collection of the Royal College of Surgeons was based on the natural, as opposed to the artificial, system, such as we see adopted at South Kensington, which, however, existed there before his appointment, and which, no doubt, is still forced upon him by circumstances not under his control.

The Keeper of the Department of Geology is fortunate in having obtained for the preparation of this catalogue the services of one so competent to deal with the subject as Mr. Lydekker, whose valuable palæontological papers, published chiefly in the Memoirs of the Geological Survey of India, are so well known, and who appears to have brought to the study of the collection a mind unbiassed by theories of a bygone period of natural history, save in a few points which we shall presently point out, in which we trust he may have yielded rather to the respect due to the opinions of a former master of this science than to his own convictions.

The author premises (in the Introduction) that he has endeavoured, as far as possible, to follow in the lines laid down by Prof. W. H. Flower (in his "Catalogue of Specimens of Vertebrated Animals in the Museum of the Royal College of Surgeons," Part II., 1884) in respect to the nomenclature of species and genera and in regard to general systematic arrangement, and his wisdom in following such an excellent model is much to be commended. Unfortunately, however, the proviso "as far as possible" seems to have opened the way to some considerable exceptions to this good rule, which prove to be serious blemishes in a work otherwise well carried out. We can see no good reason why the simple plan of printing references in the body of the page, employed in all hitherto published descriptive catalogues of the Natural History Department, should have been abandoned in the volume before us in favour of a complicated system of foot-notes which disfigure the pages and causes the unlucky reader to keep his eyes perpetually on the move. Thus (to cite one of many instances), under the genus *Machærodus* we find arranged, in a narrow line down one side of the page, six synonyms, each provided with a minute number referring to a certain similarly numbered foot-note at the bottom of the page, in which, when found, the required reference may be made out. This trouble could have been spared the reader by simply printing the reference after the synonyms, and much space would also have been saved. But worse than this is the absence of even footnote references to synonyms, such as we notice in many places, as, for instance, under "*Hyæna striata*," where eleven synonyms with the names of their authors only, are arranged in a dismal line down the left side of the page.

Although the fossil remains are, in most cases, very carefully described, yet we regret to find but few definitions in detail of the families, genera, or species; for although definitions of still existing genera and species might possibly be omitted or much abridged, it is surely unadvisable in a descriptive catalogue to omit or abridge those of any of the truly fossil forms, however well they may be known to professed palæontologists. The author is occasionally unfortunate even in his short definitions, as, for instance, where he defines the genus *Crossopus* as having "teeth nearly the same in number as in *Sorex*, but different in colour," whereas this genus is really distinguished by having teeth nearly the same in colour as *Sorex*, but different in number (one premolar less on each side above). The expression "nearly the same in number" is curious in a scientific work. Under this genus we notice that *C. remifer*, which we considered had been long ago recognised as a synonym of *C. fodiens*, is given position as a distinct species, and, wonderful to

relate, it owes its recognition as such to two rami of the mandible!

We were at first puzzled by the numbers applied to certain premolars in the author's description of the dentition of some fossil species belonging to still existing genera, until the following paragraph in the Introduction was noticed:—"In enumerating the teeth of the typical heterodont Eutherian mammals, each tooth of the cheek series is referred to its proper position in the complete series, the first premolar always meaning the first tooth in the typical series of four, and so with the succeeding teeth." Mr. Lydekker has therefore resuscitated what we had thought was long defunct—namely, the Owenian system of expressing the homology of the teeth by imagining a fixed mode of reduction for a typical number of 44, of which the premolars, for instance, when reduced in number, are supposed to become so by symmetrical loss from before backwards; so that when, for example, two upper premolars alone remain, these must be considered to be the third and fourth. It is, however, an incontrovertible fact that in many species of mammals it is the third premolar in the upper jaw that is wanting, that further reduction is accomplished by the loss of the second, and, lastly, of the first premolar, the fourth premolar of the original series alone remaining, this tooth very rarely disappearing also. In the lower jaw of certain species with three premolars the second premolar is the first to disappear, so that here the same difficulty exists. Were the mandible of such a species to become fossil, the two remaining premolars would, by the Owenian system, be recognised as the third and fourth, whereas they would really be either the second and fourth or the first and fourth. Indeed Prof. Owen himself notices ("Anat. Vertebr.," iii. p. 374) that "in some instances the first premolar remains of small size when p. 2 and p. 3 are lost;" and Prof. Flower, commenting on the theory of reduction advanced by Prof. Owen, remarks ("Encycl. Brit.," xv. p. 353) that "if this were invariably so, the labours of those who describe teeth would be greatly simplified; but there are unfortunately so many exceptions that a close scrutiny into the situation, relations, and development of a tooth may be required before its nature can be determined, and in some cases the evidence at our disposal is scarcely sufficient for the purpose."

Space will not admit of entering upon a criticism of the geological horizons adopted, which, so far as the Tertiaries of Europe are concerned, have been slightly modified by the author from the tables given by Gaudry, Boyd Dawkins, and Max Schlosser. We note, however, with satisfaction that he has rejected the prevalent notions as to the position of the Siwalik and Pikermi beds, referring the ossiferous strata of the former to the Upper and that of the latter to the Lower Pliocene—a view, if we mistake not, urged for some time past by Mr. W. T. Blanford. We could wish for a special note on the position of the Caylux and Quercy phosphorites of Central France, referred to the Upper Eocene; for the highly specialised character of the mammalian remains from these deposits appear to throw much doubt on their supposed age.

Where there is much to blame there is also much to praise: the descriptions appear to be in most cases excellent and carefully worked out, the subjects chosen for illustration well selected, and the woodcuts (thirty-three) well executed. We hope that this volume and the next (which will probably include the remaining species of fossil Mammalia represented in the collection) will together form but a "Prodromus" to a catalogue of fossil Mammalia by the same author, which, while equalling in comprehensiveness the best of the hitherto published catalogues issued by the Trustees of the British Museum, shall, however, surpass all of them in accuracy of description and in the number and excellence of its illustrations.

THE SELF-INSTRUCTOR IN NAVIGATION

The Self-Instructor in Navigation and Nautical Astronomy for the Local Marine Board Examinations and for Use at Sea. With numerous Examples, Illustrations, Diagrams, and Charts. By W. H. Rosser. New and Thoroughly Revised Edition. (London: Imray and Sons, 1885.)

BOOKS of this character have presumably their use; and this particular one is neither worse nor better than many others which owe their being to the necessities of the examination room rather than to the wants of the practical navigator. Its table of contents is framed according to the schedule of the Board of Trade; and though it is spoken of in the preface as "adapted for use at sea," Mr. Rosser has proved in other books that he knows it can be so considered only as an indirect compliment to the Board of Trade Examinations, which have been carefully devised so as to call for the greatest possible amount of cram and the smallest possible amount of real knowledge. The "Self-Instructor" has run through many editions, and no doubt answers the purpose of the author sufficiently well: it is, he says, essentially practical and not theoretical; though he omits to say that practical is to be understood as referring to what is wanted for the examination, and that theoretical refers to any reasoning or intelligent mode of working. It is not Mr. Rosser's fault that the examination is laid down on such clumsy and really unpractical lines; and what he has professed to do he has done fairly well: though it would be as well to expunge from future editions the symbol given on p. 2, for the "observed distance between the sun's near limb and the moon's far limb"; more especially if the symbol is to be used, as on p. 304, for a distance observed to the moon's near limb.

As a little matter of history, it may be remarked that the statement on p. 364, that the method of determining the latitude by the altitudes of two stars on the same hour-circle was originally given by Mr. Bolt in the *Nautical Magazine* for 1874, is not quite accurate. Mr. Bolt, in the article referred to, makes no claim of originality, but merely says that the problem may be new to many even expert calculators. In point of fact, the method suggested itself to, and was taught and practised by, the writer of this notice in 1859, and was introduced by him into the examination papers of the Royal Naval College in 1866; since which time it has been repeatedly set as a theoretical question. In reality, it ought only to be so considered; for though it gives very good results, and the observation is by no means a delicate one, a rough approximation to the interval of time being quite

sufficient, still the method is only available on a comparatively clear night; and though the same sights may possibly be also used for the determination of longitude, it will more commonly happen that the complete position may be satisfactorily determined by Sumner's method applied to two stars having a considerable difference in azimuth.

The pages in which Mr. Rosser treats of Sumner's method are of themselves sufficient to establish what has been already said as to the practical nature of the book. In an admirable monograph published two years ago, under the title of "Stellar Navigation," Mr. Rosser has shown himself alive to the very great value of this method of determining a ship's position, and to the necessity of shortening the calculation by the use of Sir William Thomson's special tables, or by Burdwood's and Davis's azimuth tables. But no remark in the "Self-Instructor" calls attention to this, and the problem is left, in its native clumsiness, in the form suitable to the questions of the examination room. The same might indeed be said of almost all other problems, which are given without any hint of the little artifices which, in practice on ship-board, render the computation quicker and easier. In saying this, however, we attach no blame to Mr. Rosser, unless it is for calling his book "practical," or "adapted for use at sea." The book is meant to meet the demands of the examinations; and for this, at least, it appears sufficiently well adapted.

J. K. L.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

On the Cause of the Dissimilarity between the Faunas of the Mediterranean and Red Seas

THE republication by Mr. A. H. Cooke of the list of Testaceous Mollusca obtained by the late Mr. Robert MacAndrew during a dredging excursion (in 1869) in the Gulf of Suez,[1] affords data for comparison with that of the Mediterranean over its eastern part, and of which the late Mr. J. Gwyn Jeffreys has, amongst other writers, given an account.[2] The extreme dissimilarity in reference to the species will, upon such a comparison, impress the mind.[3] I propose briefly to sketch out the process by which this dissimilarity may be supposed to have been brought about.

Going back to the Eocene period, we know that the whole of the region bordering the Levant, and including large portions of the three continents, formed the bed of the ocean, and we may presume that a community of genera and species existed over the whole tract represented by those of the Nummulite limestone of the Middle Eocene period.

During the Upper Eocene period there was a shallowing of the sea-bed in many places, and corresponding deepening in others, and thus the first division of the submerged area into deep and shallow basins would have been brought about with a certain influence on the animal and plant life; but the general result may not have been considerable.

It was during the succeeding Miocene period that the differentiation of the fauna and flora of the two seas really began. Recent observations on the geology of Northern Africa, Arabia, and Palestine by Zittel, Lartet, and others, leave little doubt that the Miocene period was one during which the main lines of the future lands and seas were marked out; and the absence of deposits belonging to this epoch (except a few scattered tracts formed of shallow-water and littoral beds) over the region referred to, leads to the conclusion that land-conditions prevailed very much where we now find them, and that the submerged areas of the Mediterranean and Red Seas were dissevered by the Isthmus of Suez. It was during this period of elevation that the differentiation proceeded; the original forms of the Eocene period developing in each basin independently of one another, and becoming more divergent as time went on. The process seems to have been continued well into the Pliocene epoch, but at a time which may be indicated perhaps as "Newer Pliocene" there occurred a re-submergence of the land to the extent of 220 to 250 feet below the present level of the sea, marked by the occurrence of raised sea-beds containing shells, &c., of species still living in the adjoining waters, and of old coast-cliffs perforated by Pholas borings, like that discovered by Oscar Fraas in the cliffs of Jebel Mokattam, near Cairo, at an elevation of 220 feet above the surface of the Mediterranean, and recently described by Dr. Schweinfurth (*Zeitsch. d. deutschen geolog. Gesellschaft*, 1883). During this depression Africa became an island, and the waters of the two seas were united.

With this union of the Mediterranean and Red Seas there must have been brought about a certain commingling of the forms inhabiting their waters respectively, and hence it is somewhat surprising that there should at the present day be found such an almost entire dissimilarity as that already stated. The explanation, it seems to me, is to be found in the fact that the strait was, in its shallower portion, very shallow; and that consequently, except for the purely littoral and shallow forms of marine life, a commingling really did not take place to any great extent. To the north of Lake Timsah there occurs a ridge of ground called *El Guisr*, which rises 70 feet above the present sea-level, and another called *Tunum*, which rises 25 feet. These ridges would have caused a shallowing of the strait to the extent of their elevation, so that over the former ridge the depth of the strait would only have amounted to 180 feet or less during the greatest submergence. It is impossible to say whether these ridges are higher, or the contrary, than they were at that period; but it is a remarkable fact that the sub-fossil shells in the gravels to the south of Tunum are those of the Red Sea, and to the north those of the Mediterranean; other ridges, like that of Tel-el-Kebir, produced similar shallows. As a general result it is clear that the submersion of the isthmus during the later Pliocene period did not produce a general commingling of the forms of the two seas; and when ultimately the seas were again separated by the re-elevation of their beds, and the present isthmus established, those forms which may have passed across from sea to sea would succumb to the altered conditions of their environment. It can scarcely be doubted that the temperature of the water of the Red Sea differs considerably from that of the Mediterranean by several degrees, and the forms which belong to the former would perish in the latter, and *vice versâ*. It would be interesting to ascertain which of the two faunas more closely resembles that of the original Eocene stock.

Here, then, we have the remarkable zoological phenomenon of two perfectly distinct sets of marine forms originating in one stock only as far back as the Middle Eocene period, independently developing to such an extent that, at the present day, there are scarcely more than eighteen species (according to Prof. Issel) common to both. Now, if the beds of these two seas (the Levant and Red Sea) were to be elevated into land and their fossil contents studied by a geologist of the future, he would probably assert on the palæontological evidence that they belonged to two distinct periods of geological time! This is subject matter for reflection, at least for geologists of the present day. I may add that I have been induced to try and solve to my own satisfaction the problem here presented while engaged on a work containing the scientific observations and conclusions made during the recent expedition to Arabia Petrea in connection with the "Palestine Exploration Fund."

EDWARD HULL

[1] *Annals and Magazine of Natural History*, vol. xv. p. 322 (fifth series).
[2] *Ibid.*, vol. vi. p. 65 (fourth series).
[3] This fact has been recognised by Prof. Haeckel in his "Visit to Ceylon" and his "Arabische Korallen," &c.

Hybridization among Salmonidæ

I PERCEIVE in NATURE (vol. xxxi. p. 563) that the "National Fish Culture Association" propose cross-breeding land-locked salmon and trout as proposed by Prof. Brown Goode in "Forest and Stream," August 7, 1884. Before doing so I would venture to direct their attention to a few points.

"Land-locked salmon" is admitted to be a race of the true *Salmo salar*, which from some cause having lost its migratory instinct, now lives in lakes, never migrating seawards, while its size is less than that of its sea-going relative. But as the two species are really the same, a cross between a land-locked salmon and a trout in fish-cultivation would be identical with a cross between a *Salmo salar* and a trout.

What then has been the result of attempting the latter cross at Howietown during the last few years? November 25, 1879, this was effected between salmon milt and Lochleven trout eggs; up to now all the offspring have been sterile, none have attempted to spring out of the ponds, and the largest fish among them last year, although in good condition, was only 16½ inches long. On December 24, 1881, this cross was again made, with similar results, the largest fish last winter being about 12 inches long. (Examples are in the South Kensington Museum). Sterility, I may remark, was anticipated from this cross, while it was supposed that such would remove the anadromous instinct, and these results have occurred, but as regards improvement in size, such has not, so far, proved a success.

A cross was made between a young salmon par and a Lochleven trout, on November 29, 1883, but the young succumbed to blue dropsy of the sac. This cross was again tried November 14, 1884, when the par was a year older, and so far the young look well, but we can scarcely anticipate their proving fertile offspring. I say "scarcely," for we know that domestication eliminates sterility in some races of hybrids, and in this instance the par had been raised from eggs at Howietown; these have now grown into grilse without descending to the sea, and given eggs. Eggs thus furnished from Howietown-raised grilse have hatched, and several thousand young par are in the establishment, the future of which race will be an interesting study.

I think I am justified in advising that when crossing salmon with trout, not to select a parent from a river or lake, but, if possible, to obtain eggs or milt from a race of salmon which has been two or more generations in a semi-domesticated condition, as with such the probabilities of failure are considerably lessened, but, so far as I have witnessed, hybrids between salmon and trout have proved sterile and undersized.

Cheltenham FRANCIS DAY

Forms of Leaves

IN a recent issue of NATURE, in the discussion on the forms of leaves, Mr. Henslow seems to doubt the assertion of Sir John Lubbock that the holly produces prickly leaves on the lower branches, and smooth leaves without spines above; but this is a fact which may easily be verified in numerous localities (selected gardens varieties are of course not intended). I know of a large tree at Kew which altogether confirms the statement. The explanation, however, that the spines of the lower leaves may be produced to prevent animals from browsing on them, and that they are not developed on the upper branches because these are beyond the reach of animals, seems to me to require some modification, if not to be given up altogether, in this limited sense. It seems to me to admit of a much simpler explanation, namely, that it is an approximation—or reversion, if indeed the term be applicable—to the ancestral type. It is a well-known fact that in the embryonic stage of an organism the affinity with the ancestral type is best seen, and that in the mature stage the greatest amount of specialisation takes place; and, viewed in this light, the case of the holly does not appear to present much difficulty. A young seedling is seen to have very spiny leaves, but with increasing age the leaves becoming comparatively spineless. In the case of the furze we have the most overwhelming evidence that the spiny character has been developed to repel the attacks of herbivorous animals, and a young seedling is seen to have trifoliate leaves—like the laburnam—from which we infer that its ancestral type was spineless, and had trifoliate leaves. The large group of phyllodineous Acacias bear an equally unmistakable stamp of their origin in the bipinnate leaves which the seedlings at first produce. In most cases these leaves are very early superseded by phyllodes, but in *A. melanoxylon* the habit of producing true leaves is never quite lost. There is a large tree of this species about 40 feet high at Kew, at the south end of the Temperate House, close to the spiral staircase. It is thus in an admirable position for examination. At the base of this tree the leaves predominate over the phyllodes, but in ascending the staircase the proportion is seen to gradually diminish, till at the top of the tree—a few feet above the gallery—scarcely a true leaf is to be seen. Assuming the mature stage to be the more highly specialised, we have in the holly a precisely parallel case. This necessarily involves the opinion that the ancestral type of the genus *Ilex* had spiny leaves; and, if so, it seems highly probable that the character was developed as a protection against the attacks of herbivorous animals. A possible objection which at first struck me was that many of the species have quite smooth leaves; but this has been removed by a search through the specimens in the Kew Herbarium. In the first place, species with spiny leaves occur in each great centre of distribution of the genus—in North and South America, India, China and Japan, the Atlantic Islands, as well as Europe—and in the second, although no seedling plants were found, there are three species which show very spiny leaves on barren branches, and smooth leaves on the more mature flowering branches. These are *I. insignis* and *I. dipyrena*, from India, and *I. Perado*, from the Atlantic Islands. I have little doubt that seedlings of many species would present the spiny character if we could only see them. The presence of spines—the nerves being extended beyond the margin of the leaf—seems to indicate an excess of vascular over cellular tissue; a condition which is either modified with increasing maturity or is not exhibited in the same phenomena. In any case a severe pruning—or reduction of the parts to be nourished—is followed by a temporary reversion to the more spiny character. If this explanation be the correct one the question naturally arises, Why are the hollies losing the property of producing spiny leaves? rather than, Why does the holly produce spiny leaves on its lower branches? The answer to the first query would perhaps be, Because they no longer need the protection afforded by the spines. To the second, Long-continued habits are not often instantly laid aside.

Herbarium, Kew, April 18 R. A. ROLFE

Kite-Wire Suspended Anemometer Readings

HAVING lately made some observations with my anemometers elevated, as above described, at heights above the ground considerably greater than those mentioned in my paper before the British Association last year, I venture to think that a word or two as to the main point at present under investigation, viz. the general increase in the velocity with the altitude at heights between 600 and 1100 feet above the ground, may be interesting to your readers.

Up to June last the greatest altitude reached by the anemometers was 646 feet. I have lately been able to secure readings up to 1129 feet. Taking the average of seven of these, we get the following values for the mean relative velocities at two mean heights:—

Height in feet above ground.	Velocities in feet per minute.
1070	2297
756	2165

When these values are inserted in the formula $\frac{V}{v} = \left(\frac{H}{h}\right)^x$, we get for the value of the exponent $x = 0{\cdot}17$, or a little more than $\frac{1}{6}$; but when 500 feet—the elevation of the place of observation above the sea—are added to each elevation, we get $x = 0{\cdot}26$, or almost exactly $\frac{1}{4}$, which is the value I deduced for the exponent in NATURE (vol. xxv. p. 506), from a discussion of Dr. Vettin's cloud observations.

I would not at present lay much stress upon this coincidence until I have investigated the ratio up to heights of 2000 feet or more, but I certainly think it supports the notion that the formula with this exponent represents the average law of increase at heights over 1000 feet above sea-level.

E. DOUGLAS ARCHIBALD

Temperature of the Body of Monotremata

I HAVE found the temperature of the body of *Echidna hystrix* to be (average of three observations) 28°·0 C., and that of *Ornithorhynchus paradoxus* (two observations) 24°·8 C.[1]

These temperatures present a special interest, comparing them with the mean temperature of the body of mammalia in general, which is (after Dr. J. Davy's observations of thirty-one different species) 38°·4 C. N. DE MIKLOUHO-MACLAY

Biological Station, Watson's Bay, near Sydney, N.S.W., March 10

[1] Details of these observations can be found in the *Proceedings* of the Linnean Society of New South Wales, vol. ix. pp. 425 and 1204.

Quinquefoliate Strawberry

It may interest botanical readers to know that we have here a variety of strawberry many petioles of which bear five leaflets. This kind of leaf is also transmitted to its offspring when propagated by runners, and I think it may be possible to raise from seed progeny the whole of whose petioles will bear five leaflets. It is an excellent variety in every respect; the fruit is symmetrical, and of rich flavour. When we consider that Duchesne's strawberry, *Fragaria monophylla* (described by Mr. Dyer in NATURE, vol. xxix. p. 215), was unifoliate, and that ordinary strawberries are trifoliate, this variety certainly is unique, and suggests still further possibilities of development in the genus Fragaria.

J. Lovell

Driffield, April 16

SOME OF THE METEOROLOGICAL RESULTS OF THE TOTAL SOLAR ECLIPSE OF MAY 6, 1883 [1]

In the expedition sent by the United States Government to Caroline Island (9° 59′ 45″ S. lat. and 150° 14′ 24″ W. long.) to observe the total eclipse of May 6, 1883, provision was made for taking a series of meteorological observations on the occasion. The observations, which were of an elaborate description, are fully detailed and summarised by Mr. Upton in the Report, and they present results of exceptional interest.

During the eclipse the velocity of the wind remained practically constant, and, so far as the readings of the radiation thermometers showed, the heat received by the earth was almost *nil*. The temperature of the air, which, previous to the eclipse, had been 84°·5, fell to 81°·4, or 0°·1 lower than it had been at 7 a.m., and 0°·6 lower than it was at 9 p.m. The amount of the temperature depression due to the withdrawal of the sun's heat was 3°·9; and, corresponding with this lowering of the temperature, the relative humidity increased 5 per cent. during the eclipse.

The main interest of the observations, however, centres in the influence of the eclipse on the diurnal barometric curve. The diurnal march of the atmospheric pressure in these regions may well be classed among the most regularly recurring phenomena of terrestrial physics. From hourly observations made from April 25 to May 5 the mean at 10 a.m. was 29·957 inches, and at 2 p.m. 29·844 inches, the barometer thus falling in these four hours 0·113 inch. Between these hours, on May 6, the eclipse occurred, the total phase of the eclipse being from 11·32 to 11·37 a.m. On that day the barometric curve presented a form wholly different from what is daily observed in these regions. From 10·30 to 11·25 a.m. the barometer fell with a greater rapidity than the normal rate of fall, being at 11.20 a.m. 0·016 inch lower than the normal at that hour. Immediately thereafter a rapid and abnormal rise set in, the usual fall being arrested and replaced by an actual rise, so that while pressure at 11.20 a.m. was 29.927 inches, at 11.50 a.m. it was 29·940 inches. At 12.10 p.m. it was 0·019 inch above the normal for that hour. Since the barometer was 0·016 inch lower than the normal at 11.20 a.m., and 0·019 inch higher at 12.10 p.m., it follows that the disturbance from the normal values during these fifty minutes occasioned by the eclipse amounted to 0·035 inch, being equal to nearly a third of the whole diurnal oscillation from the morning maximum to the afternoon minimum.

The time and manner of this abnormality is of special significance, inasmuch as it indicates a more rapid fall than the average during the first partial phase, when the sun's heat began to be cut off, and a rise above the average wholly exceptional after the close of the total phase, the maximum rise being delayed thirty-three minutes after the period of totality. An eclipse differs essentially from all other influences affecting the atmosphere, in that it cuts off the sun's heat from a restricted section of the earth's atmosphere extending from the surface to the extreme limits of the atmosphere, while from the air surrounding the shaded region the sun's heat is not cut off. Now, the observations showed that the first effect of the cutting off of the sun's rays and consequent reduction of the temperature, which no doubt extended through the whole height of the atmosphere, was to lower the pressure below the normal. This diminished tension was simply the direct result of the lowering of the temperature of the air over the region where the barometric observations were made.

Following this diminution of the pressure, an inflow of air towards the retreating path of the shadow set in, and pressure quickly rose above the normal of the hour, and as the sun's rays now heated the air with this excess thus temporarily accumulated over Caroline Island, pressure rose still further, till at thirty-three minutes after the close of the total phase it was 0·019 inch above the normal. Thereafter pressure fell with a corresponding rapidity during the next twenty minutes, at the close of which time it stood at the normal. The whole phases of the disturbance in the diurnal march of the pressure caused by the eclipse occupied two hours ending with 12.30 p.m. It is from their bearings on the theory of the diurnal oscillations of the barometer that Mr. Upton's observations must be regarded as of the highest importance (see "Encyclopædia Britannica," *Meteorology*, pp. 122 and 123).

Pointed attention is given in the report to the observations of the wind, which showed that, though the island is situated in the region usually included in the south-east trades, yet the direction of the wind was almost always noted as east or north-east, and was at no time observed to be from any other quarter than between north and east. Not a single observation during the time the expedition was on the island gave a direction south of east. The *Challenger* in this part of its cruise, during September, 1875, noted the same directions of the wind, and during the cruise to southward the north-east trades were not left till lat 13° S. was reached.

During the voyage from Callao, the *Hartford* sailed day after day in the region of the south-east trades, upon almost the same parallel of latitude, and with but few changes in the position of the sails, no steam being used. Since the conditions were so constant during the twenty-two days in which the vessel sailed in lat. 11° 5′ S. from long. 79° to 137° W., a tabulation of the hourly speed of the vessel day by day has been made from the ship's log. The mean values show a distinct increase in the evening, and a corresponding decrease in the morning, the maximum, 6·8 miles per hour, occurring at 10 p.m., and the minimum, 5·9 miles, at 10 a.m. With reference to the result, Mr. Upton remarks that, "It seems fair to attribute this to a diurnal variation in the wind's velocity. There is quite an unexpected regularity in the progression when we consider the approximate nature of the method. If not attributable to diurnal change in the wind itself, it yet indicates a diurnal change in the effect of the wind upon the sails, and is therefore of interest."

[1] Report of observations made on the expedition to Caroline Island to observe the total solar eclipse of May 6, 1883, by Winslow Upton. (Washington, 1884.)

SIR WILLIAM THOMSON ON MOLECULAR DYNAMICS [1]

III.

Before proceeding with new parts of this subject, I wish to say a few words about "fiddling while Rome is burning." Sir William Thomson writes to me that the expression was used while discussing some mathematical triviality, and he wishes to be relieved of the imputation

[1] Continued from p. 510.

of speaking disrespectfully of *anomalous dispersion*, which he says is quite as important as *double refraction*. I grant this, but my interpretation of his language when I heard the lecture was that so many possible ways had been shown of explaining anomalous dispersion that it was mere child's play (or fiddle-playing) to discuss it while the burning question of double refraction awaited explanation, upon which question seems to depend the whole safety of the wave-theory of light, that theory being in imminent danger of destruction therefrom.

I shall now give a brief account of the gyrostatic molecules, crude and improved. The crude one is a fly-wheel inside a massless shell. Here there is no gyrostatic action opposing a motion of translation, but only opposing a motion of rotation. This is the molecule which was stated to give the wrong kind of variation of magneto-optic rotation with variation of wave-length. The improved gyrostatic molecule (p. 320) consists of two fly-wheels on one axis. But the axis is cut in two in the middle between them, and the parts fitted together by a ball and cylinder joint. The other ends of the half axes are supported in ball-and-socket joints in the massless shell. So far as rotation of the shell is concerned, this acts like one gyrostat, the axis always remaining in one line. But if the shell be frictionless, the ether can only give translational movement to it, and the double gyrostat produces a gyrostatic effect when the molecule is accelerated in any direction except along the axis.

The special function of this molecule is to explain magneto-optic rotation of the plane of polarisation. The axis of the molecule is supposed to be the direction of the lines of force. It is required to be proved that, gyrostatic molecules being imbedded in the ether with their axes parallel and their directions of rotation the same, the velocity of propagation of a circular disturbance going with the gyrostat is greater than that of a circular disturbance in the opposite direction. With a steady propagation of circularly polarised light, the gyrostats will clearly execute a precessional motion. The theory of this motion is examined after the manner of Thomson and Tait's "Natural Philosophy" for a ray along the axes, and the gyrostatic effect is found to be equivalent to altering the effective density of the molecule, and so altering the velocity of propagation. Thus if v and v' are the velocities of propagation along the axis of rays polarised circularly in the two directions, it comes out that approximately

$$\frac{v}{v'} = 1 + h\frac{\omega}{\gamma},$$

where h is a constant depending on the form of the gyrostats, ω is the angular velocity of the precessional rotation of the gyrostats, and γ is the velocity of rotation of the gyrostats. This is a totally different law to the action of the *crude* gyrostatic molecule, and is in accordance with experiment.

If now we have *improved* gyrostatic molecules imbedded in the ether, their minute rotations will affect the velocity of propagation in the manner of crude molecules, but their translations will affect the velocity in the manner now elucidated. But observe that by diminishing the size of the molecules the influence of the rotational motion diminishes, but the influence of the translational motion remains the same (on the assumption that the angular gyrostatic velocity is kept the same and the ratio of mass of gyrostats to mass of molecule remains the same). Hence, if we have small enough molecules, the law which agrees with experiment alone holds. This is a very satisfactory state of affairs, and I believe it is the first time that Sir William Thomson's hint about this phenomenon, so long ago thrown out, has been developed.

There is still so much matter in the lectures that I have not touched upon that I am in some difficulty as to what to omit. But I certainly should like to transcribe nearly the whole of the last lecture. This is of course impossible, but I will claim a little space for some remarks on Rankine's beautiful but futile attempt to get over the fatal difficulty of double refraction (p. 271):—

"Suppose here a massless rigid lining of our ideal cavity in the luminiferous ether. Let there be a massive, heavy molecule inside, with fluid around it. The main thing is that this molecule, which only affects the effective inertia of the ether by adding its own mass to the moving mass of the ether, has æolotropy of inertia. Imagine this spherule (drawing on the board an oblate spheroid with axis vertical) moving first in a horizontal direction. The effective inertia of this sheath will be altered if it moves to and fro in a vertical direction, there being, by hypothesis, liquid between it and the ether. The density of this mass must be greater than the density of the liquid, that is all. If there is danger of its coming to the sides of the cavity, let there be springs to keep it in place, if you like, but let its connection with the lining of the cavity be in the main through fluid pressure. Then its effective inertia is different in different directions. This fluid lining seems to hit off the very thing we wanted. Now comes Rankine's want of strength. He cut around the edges of it, and, I think, rather jumped at it, and put down a wave-surface the same as Fresnel's, and said that it came to that. But, alas! Stokes (long before Lord Rayleigh suggested it) showed that it would give a different surface from Fresnel's. Lord Rayleigh, in repeating Rankine's suggestion, showed his strength where Rankine was not so strong in mathematical powers of grappling with a difficult mathematical problem. Lord Rayleigh is a man who grapples with a difficulty and sees how much he can do with it. He puts it aside if he cannot solve it, but he never shirks it. Rankine was not a mathematician in that sense at all. Lord Rayleigh finds, not Fresnel's wave-surface, but a wave-surface differing from Fresnel's by certain terms appearing in reciprocals instead of directly."

Now Stokes has shown that Huyghen's construction satisfies experiment with great accuracy, and hence Rankine's effort fails. The desperate condition of the wave-theory is shown by the words penned by Lord Rayleigh before he knew of Stokes's experiments (p. 272): "Should the verdict go against the view of the present paper, it is hard to see how any consistent theory is possible which shall embrace at once the laws of scattering, regular reflection and double refraction."

It appears, then, that after all the labour which has been expended upon the wave-theory of light, it fails absolutely, and, as it seems, hopelessly, in two points of primary importance. One is the extinction of the ray polarised by reflection; the other is double refraction. In other matters we have difficulties, but we can see a possible means of escape. Here there seems to be none.

Before concluding this series of articles I wish to say a little more about the manner of their delivery. It is a rare experience for students to have the opportunity of studying the workings of a great mind while grappling with a problem. This is what occurred during the three weeks of the Baltimore lectures. During the whole of this period one or two ardent students were hunting up references in the Peabody Library, &c., and literally filled Sir William Thomson's rooms with the results of their searches, and Sir William generally read these books. He says (p. 76):—"An interminable number of books have been brought to me, and in every one of them I have found something very important." But at p. 98 he says:—"I got another quarter-hundredweight of books on the subject. I have not yet read them all through." In this way he often came for the first time upon researches bearing on the question in hand. Thus (p. 77): "I only found this morning that Lommel also goes on to double refraction of light in crystals [with imbedded molecules]. The very problem I am breaking my head

against." Evidence is always cropping up that the author is in the habit of going farther into a subject by original mathematical analysis than by reading up other people's work. I will give some examples. Speaking of a reference by Rankine to cubic asymmetry, he says :—"I only came across this in Rankine two or three days ago. But I remember going through the same thing myself not long ago, and I said to Stokes—I always consulted my great authority, Stokes, whenever I got a chance—'Surely there may be such a thing found to exemplify this kind of asymmetry; would it not be likely to be found in crystals of the cubic class?' Stokes—he knew almost everything—instantly said: 'Oh, Sir David Brewster thought he had found it in cubic crystals, but there was an explanation that it seemed to be owing to the effect of the cleavage planes or the separation of the crystal into several crystalline laminæ'" (p. 158). Then again he says :—"I am ashamed to say that I never heard of anomalous dispersion until after I found it lurking in the formulas. I said to myself, 'These formulas would imply that, and I never heard of it;' and when I looked into the matter I found, to my shame, that a thing which had been known by others for eight or ten years I had not known until I found it in the dynamics" (p. 120). Once more we find :—"I was thinking about this, three days ago, and said to myself, 'There must be bright lines of reflection from bodies in which we have those molecules that can produce intense absorption. Speaking about it to Lord Rayleigh at breakfast, he informed me of this paper of Stokes's, and I looked and saw that what I had thought of was there. It was known perfectly well, but the molecule first discovered it to me. I am exceedingly interested about these things, since I am only beginning to find out what everybody else knew, such as anomalous dispersion, and those quasi colours, and so on" (p. 282).

The purely physical bent of the author's reasoning is well shown in speaking of Rankine's work at p. 270: "I do not think I would like to suggest that Rankine's molecular hypothesis is of very great importance. The title is of more importance than anything else in the work. Rankine was that kind of genius that his names were of enormous suggestiveness, but we cannot say that always of the substance. We cannot find a foundation for a great deal of his mathematical writings, and there is no explanation of his kind of matter. I never satisfy myself until I can make a mechanical model of a thing. If I can make a mechanical model, I can understand it. As long as I cannot make a mechanical model all the way through, I cannot understand; and that is why I cannot get[1] the electromagnetic theory. I firmly believe in an electromagnetic theory of light, and that, when we understand electricity and magnetism and light, we shall see them all together as part of a whole. But I want to understand light as well as I can without introducing things that we understand even less of. That is why I take plain dynamics. I can get a model in plain dynamics, I cannot in electromagnetics. But so soon as we have rotators to take the part of magnets and something imponderable to take the part of magnetism, and realise by experiment Maxwell's beautiful ideas of electric displacements, and so on, then we shall see electricity, magnetism, and light closely united and grounded in the same system."

The model of an electromagnetic ether described by Prof. Fitzgerald on March 28 to the Physical Society, founded on Clerk Maxwell's celebrated papers in the *Philosophical Magazine* in 1860 and 1861, goes a long way to clear away the objection raised by Sir William Thomson.

In reading these lectures, it must be remembered that they are uncorrected *verbatim* reports, and one is surprised at seeing that the matter is so continuous and readable. A considerable freshness is given by the conversational interludes and remarks, which would not perhaps have appeared in a written work. As mentioned before, Sir William spoke of the pressural wave as an animal; this was very happy, as he had just before called it the *bête noir* of the mathematicians. He says at p. 34:—"I do not like the words 'paradoxical phenomenon.' 'Curious phenomenon' or 'interesting phenomenon' would be better. There is no paradox in science. We may call it a *dynamox*, but not a *paradox*." At p. 115 he says:—The struggle of 1815 (that is not the same idea as *la grande guerre de* 1815) was, who was to rule the waves, Cauchy or Poisson?"

To many it will seem, after reading these lectures containing a review of what has been done and suggestions of what might be done, that certain facts are hopelessly irreconcilable with the wave-theory of light. Sir William Thomson has certainly not shirked a single difficulty, and perhaps has even made them look more glaring than is necessary. But, if this be an error, it is on the right side.

The reporter has introduced into the volume some doggerel rhymes read by a certain student of the lectures at a farewell dinner at Baltimore given by President Gilman :—

The Lament of the Twenty-one Coefficients at parting from each other and from their Esteem d Molecule

An æolotropic molecule was looking at the view,
Surrounded by his coefficients twenty-one or two,
And wondering whether he could make a sky of azure blue,
With plagiotatic *a b c* and thlipsinomic *Q*.

They looked like sand upon the shore with waves upon the sea,
But the waves were all too wilful and determined to be free;
And in spite of *n's* rigidity they never could agree
In becoming quite subservient to thlipsinomic *P*.

Then web-like coefficients and a loaded molecule,
With a noble wiggler at their head, worked hard as Haughton's mule;
But the waves all laughed, and said, "A wiggler, thinking he could rule
A wave, was nothing better than a sidelong, normal fool."

So the coefficients sighed, and gave a last tangential skew,
And *a* shook hands with *b* and *c*, and *S* and *T* and *U*,
And with a tear they parted; but they said they would be true
To their much-belovèd wiggler and to thlipsinomic *Q*.

Signed, (g, f), A CROSS COEFFICIENT NOW ANNULLED

The social and scientific intercourse of these three weeks at Baltimore was an experience that will be forgotten by none of the twenty-one coefficients, and they all sympathised with Sir William Thomson in his concluding remarks at p. 289:—

"I am exceedingly sorry that our twenty-one coefficients are to be scattered, but, though scattered far and wide, I hope we will still be coefficients working together for the great cause we are all so much interested in. I would be most happy to look forward to another conference, and the one damper to that happiness is that this one is now to end, and we shall be compelled to look forward for a time. I hope only that we shall all meet again in some such way. I would say to those whose homes are on this side of the Atlantic, 'Come on the other side and I will welcome you heartily, and we may have more conferences.' Whether we have such a conference on this side or on the other side of the Atlantic again it will be a thing to look forward to—as this is to look back upon—as one of the most precious incidents I can possibly have. I suppose we must say farewell!" GEORGE FORBES

[1] These reports are generally quite *verbatim*, but I am sure Sir William Thomson is not responsible for this characteristic Americanism.—G. F.

THE SEMAPHORE AND ELECTRIC LIGHT AT SHANGHAI

THE European and American community occupying the so-called foreign concessions in Shanghai has ately adopted the electric light. The illustration given

below is the reproduction of a Chinese drawing representing the light and a semaphore with a time-ball in the French concession. It is taken from *La Nature*, and originally appeared in a Chinese illustrated journal called the *Hu-pao*, which described the illustration in the following manner :—

"On the French concession, at the end of the settlements of the other foreign nations, a semaphore which marks the hour and the wind was erected last autumn. Every day at 10 o'clock a flag is hoisted which denotes the wind that is blowing on the sea at the mouth of the river. Every day at 11.45 a ball is raised to half mast, and five minutes before noon it is raised to the top. Precisely at noon it falls. In this way all the people of Shanghai can know the exact hour. The flags vary in form, in number, and in colour, according to the direction and force of the wind. Truly, it is a very good thing."

The illustration represents the semaphore to the left,

with the Chinese looking up at the ball which is about to be raised. The semaphore was erected on September 1, 1884, at a cost of 28,000 francs, by the French Municipal Council. It gives the hour at noon, and the force and direction of the winds at the mouth of the Yang-tsze-kiang. It is connected with the Zikawei Observatory, which receives the observations respecting the wind from Gutzlaff Island, at the mouth of the river, and which the director of the Observatory, Père Dechevrens, passes on by telephone to the assistant in Shanghai. The time-ball is in direct connection with Zikawei. The wires, poles, and lamps of the electric light are also noticeable in the illustration. The light, which was set up last year, appears for some reason not to be successful, and when the last mails left Shanghai the Municipal Council were in correspondence with the gas company with the object of coming to an arrangement for a return to lighting the streets with gas.

VARIABLE STARS

IN his stirring "Call to Friends of Astronomy" (*Schumacher's Jahrbuch*, 1844) to aid the advance of the science by taking up some definite department of work, Prof. Argelander, among other points for investigation, drew attention to the observation of variable stars as presenting a fascinating field of inquiry in which much valuable work might be done. Forty years have passed since this appeal was made. The list of eighteen stars visible in these latitudes then certainly known to be variable has grown to at least ten times the number, while a new "instrument of precision" has been placed in the hands of the observer in the form of the spectroscope, which has largely increased his powers. But, after all, it must be acknowledged that we are still greatly in ignorance of the causes which immediately underlie the striking phenomena which are presented to our view.

In taking a rapid glance at some of the phenomena with which we have to deal, it may be convenient to

adopt some form of classification of variable stars. The following arrangement suggested by Prof. Pickering will suit our purpose; but at the same time it should be remarked that links of association may sometimes be discovered between individual members of different classes in respect of some of their characteristics. It is probable, too, that after all some stars must remain unclassed.

"Class I. Temporary stars, or those which shine out suddenly, sometimes with great brilliancy, and gradually fade away. Examples: Tycho Brahe's star of 1572; new star in Corona 1866.

"Class II. Long-period variables, or those undergoing great variations of light, the changes recurring in periods of several months. Examples: o Ceti and χ Cygni.

"Class III. Stars undergoing slight changes according to laws as yet unknown. Examples: α Orionis and α Cassiopeiæ.

"Class IV. Short-period variables, or stars whose light is continually varying, but the changes are repeated with great regularity in a period not exceeding a few days. Examples: β Lyræ and δ Cephei.

"Class V. Algol stars, or stars which, for the greater portion of the time, undergo no change in light, but every few days suffer a remarkable diminution in light for a few hours. Examples: β Persei (Algol) and S Cancri."

The temporary or new stars form a remarkable class of stars, which blaze unexpectedly into view and then gradually decline. A striking object of this class was Tycho Brahe's star of 1572, which attained such a brilliancy as to be visible by day. It was not, however, till the year 1866 that a clue was found to the probable nature of these outbursts, when the examination of the spectrum of the new star which appeared in Corona Borealis in May of that year by Dr. Huggins suggested the view that in these cases the outburst is due to the liberation of large volumes of gas, which enwraps the star in a flaming envelope which gradually burns itself out.

The most recently-observed star of this type has a curious history. On September 24, 1876, the late Dr. Schmidt discovered, in the constellation Cygnus, a new star of the 3rd magnitude, which soon began to fade. Like the star T Coronæ it had a double spectrum. In September, 1877, when the star had fallen to 10·5 mag., an examination of its spectrum at the Earl of Crawford's observatory showed that the continuous spectrum had disappeared and that the star's light was monochromatic. In fact, to all appearance the star had become a minute planetary nebula!

The distinguishing characteristic of stars of this type, namely the temporary character of their phenomena, sharply marks them off from the variables of all the other classes, in which the changes recur with greater or less regularity. A connecting-link, however, may perhaps be found in the remarkable variable, U Geminorum, discovered by Mr. Hind in 1855. It has a very irregular period, which ranges between 70 and 126 days, during about three-quarters or more of which time it remains fluctuating about a minimum magnitude of 14·5. It rises rapidly to maximum (at the maximum of February, 1877, at the rate of over three magnitudes in twenty-four hours), and then, at first gradually and then more rapidly, falls to minimum again. Its colour has generally been described as bluish-white (though it has been noted ruddy), and a curious, ill-defined or hazy appearance has been noticed by several observers which would suggest the possibility of bright lines being found in its spectrum, a suspicion which has not as yet been confirmed.

Class II. includes by far the greater number of known variable stars. Many of these are highly coloured, showing tints of red or orange of various degrees of intensity, and among them are to be found stars having fine banded spectra of Secchi's types III. and IV. The regularity with which they go through their changes is of various degrees, and varies even in the same star at different times, while in some cases there is evidenced a tendency to form subsidiary maxima or minima on the main light curve. In some instances also the magnitude touched by the same star at maximum or minimum is subject to fluctuations, and this apparently quite independently of the degree of regularity with which the changes are gone through in respect of time. In two stars at least of this class—Mira Ceti and R Geminorum—bright lines have been observed in their spectra.

It is perhaps to be regretted that a separate class has not been formed for variable stars having a double period, with two equal or nearly equal maxima and two unequal minima, of which β Lyræ is the type. A star of this order, with a period of about 70 days, R Sagittæ, included in Class II. (though with an expression of doubt) in Prof. Pickering's list, seems to call for special remark. It was discovered by Mr. Baxendell in 1859, and his observations have shown first the approach to equality and then the reversal of the principal and secondary minima. The equalisation of the minima was also observed by Prof. Schönfeld, and their reversal by Mr. Chandler in America. The phenomenon thus exhibited is a remarkable one, though perhaps not unique, as something similar appears to have been noticed by Prof. Argelander and Prof. Schönfeld in the case of R Scuti.

Turning to Class III., a point should be mentioned in regard to one of the examples of the class α Orionis. Observing the star in March, 1866, Dr. Huggins noticed that "a group of lines and shading, as if of fine lines" had disappeared from its spectrum, the star at the time being at its maximum brilliancy. Six years later, however, Dr. Vogel, at Bothkamp, failed to detect any change of this character.

Passing to Class IV. we have, in one of the examples, β Lyræ, a star presenting points of singular interest. As has been already mentioned, its period of 12·9 days is a double one, with two equal maxima and two unequal minima, and Herr E. von Gothard, of the Herény Observatory, has discovered that its spectrum is also variable. Herr von Gothard has also observed the D_3 line (showing that Helium has a home in other suns than ours), and the lines of hydrogen as bright lines, and has further (*Astr. Nach.*, No. 2651) found them to vary in intensity in a period of about seven days. Further observation is required before any decided opinion can be expressed as to the relation between the variation of the spectrum and the variation of the star's light, but a comparison of Herr von Gothard's observations with the predictions of an ephemeris seems to suggest (though the evidence is not quite conclusive) that the bright lines are at their brightest when the star is near a minimum.

The stars of Class V., of which Algol is an example, form a group of variables of a well-marked type. The general features of their changes are fairly represented by the supposition of an eclipsing satellite. But in the case of U Cephei, a star of the group discovered a few years ago by Ceraski, a new feature is introduced which somewhat complicates the theory. Its period has been shown with some degree of probability to be a double one, with slightly unequal minima. Another curious fact which has been observed in regard to the star is that, as it falls below the 8th magnitude, its light becomes decidedly ruddy (indicating absorption as well as eclipse?), the ruddy colour being lost as the star rises to the 8th magnitude again, when it regains its ordinary brilliant bluish-white hue. It is only fair to remark that in Prof. Pickering's view the suggestion as to the duplicity of the star's period should be at present received with caution.

This brief review will suffice to show that any attempt to answer the question—What is a variable star?—involves the examination of a multiplicity of phenomena. At the same time, the causes presumably at work may be grouped broadly under two heads—geometric and chemico-physical. We have seen that in the case of the

temporary stars we have grounds for looking to the *latter*, while in the case of stars of the Algol group we have reasons for looking to the *former*, as a more or less probable cause of the changes we observe. While in β Lyræ we see that physical changes apparently accompany, if they are not connected with the cause of, the light variation. Is it to geometric or to chemico-physical causes that we are to look as the key to the explanation of the phenomena in other groups, say of the large group of Class II.? A few considerations will show the grave difficulties we have to meet. A difference of from five to seven magnitudes between the points touched by the star at maximum and minimum is to be found in the case of many members of Class II. Now, taking the magnitude scale at present generally adopted, having a light-ratio of 2·512, a range of five magnitudes would correspond to a difference of light-intensity in the proportion of 100 to 1, while if the range is extended to seven magnitudes, the star's light-intensity at maximum would bear to its light-intensity at minimum a ratio of 630 to 1. These wide differences of intensity of radiation are sufficiently startling if they are supposed to occur only once in a while, as in the case of the temporary stars. What are we to say of them if we are to suppose them to occur over and over and over again, in periods of from 150 to 600 days? The subject was discussed in these columns some few years ago, and the difficulties presented were felt to be so serious as to make it hard to accept a theory of this kind as offering a probable explanation of the facts if these stars are to be regarded as suns in the usual sense of the term, though less difficulty might be felt if we could look on them, not as suns in our sense at all, but as small bodies. In this case they would be relatively near to us, and would have a measurable parallax. An inquiry in this direction might prove fruitful. As compared with this theory, the theory that the changes of light may be supposed due to periodic obscurations by bodies or groups of bodies revolving around the variable, presents less formidable objections, though it has, of course, difficulties of its own. A few months ago one of our first authorities on the subject penned the words: "No theory has yet been advanced that will account satisfactorily for the ordinary phenomena of variable stars." It is possible that we must look forward to a future of more or less lengthened patient research before theoretic views can be announced which shall be anything much better than "guesses at truth."

It is, then, to further work that we must look for further progress, and the recent discoveries in regard to β Lyræ indicate one direction at least in which research should be made. Is it not possible that some valuable results might be obtained if the spectra of a selected list of variable stars were to be carefully studied with one of our largest telescopes—the several spectroscopic results being co-ordinated with the corresponding position of the star in its light-curve as fixed by a careful determination of its magnitude? In the discovery of new variables, the determination of their periods and range of variation, and of the general characteristics of their light-curves, good work may be done with instruments of very moderate dimensions; but for all but the brighter stars the spectra are too faint to be adequately treated but by instruments of the largest size.

Whether by this means any satisfactory results should be obtained or no, it is evident that in the study of variable stars a point has been reached whence, in order to secure any further advance, it seems needful by some means or other to endeavour to take a new departure.

THE LATE EARL OF SELKIRK

On Saturday, April 11, 1885, Dunbar James Douglas, sixth and last Earl of Selkirk died, after a short illness, at St. Mary's Isle, Kircudbright; had he lived till the 22nd of the month he would have completed his seventy-sixth year. His death, though it occurred at a ripe age, has proved a sudden and unexpected blow to those who hoped that many years of life might yet remain to one upon whose spare and still vigorous frame, age had as yet apparently made but little impression, and whose mental and physical energy alike gave promise of a still prolonged period of utility. Those who so recently saw him in even more than his wonted health now sadly realise the fact that he has succumbed, like many others, to the evil influences of the treacherous and bitter east winds which for some time swept over our islands, and terminated his valuable life after a short illness of but three weeks. How much he is regretted, how sorely he will be missed, it is impossible to say; for the removal of one so gifted and so good is an irreparable loss, which will be felt more and more as time progresses, wherever the genial influence of his life and example had been felt

Elsewhere have been described his ancient lineage, his connection with various great families of historic fame, his political opinions, his public life, the high offices he filled in the State and in his county, the charms of personal character which marked his whole life; his education at Eton, his success at Oxford, his travels and explorations in almost every quarter of the globe; the rich harvest of experience he so assiduously collected and so carefully and accurately remembered; his thoughtful, unselfish nature, so loyal, so considerate of others, especially of the weak; so firm in assertion of all that he believed to be right, so excellent in all relations of public, private, and domestic life, so true a friend, so mindful of all who ever did or tried to do him the slightest service—all this may some day be told again in detail, but need not be dwelt on here in this brief notice, which contemplates rather the side of his nature which turned towards science and took so keen an interest in its progress and welfare, he himself being no mean contributor to its annals. Those who, like the writer, have had the privilege of intimate association with him, in the field, on the moor, in social life, and by the evening fireside, and have listened to his instructive conversation on many subjects connected with natural science, history, geography and biography, and have felt the satisfaction which arises from communion with one whose wisdom and experience seldom erred, who enunciated no crude theory, made no hasty generalisation on imperfect or insufficient data, and whose judgment was tempered, calm and reasonable in all matters submitted to it for decision, must feel that, by his death, science too has sustained a serious loss.

Lord Selkirk's great erudition and knowledge of men and nature were not derived merely from books. He was, indeed, a great reader, whose memory retained with extraordinary tenacity all the details even to minute particulars of that which he read: his vast stores of information were the result of much travel and study of physical science. Few, indeed, had travelled so far, or seen so much, or with such intelligent appreciation of what they did observe.

His mind was of a truly scientific mould, and accepted nothing on insufficient or imperfect evidence; his interest in all that was calculated to extend the limits of science was unbounded; but of all its departments, geology seemed to attract him most: he was a Fellow of the Geological Society, a frequent attendant at its meetings, and a contributor to its proceedings. One paper on "Sea-water Level Marks on the Coast of Sweden," read before the Society in 1867, was of much interest, and shows how closely he had studied that important subject. He was also a Fellow of the Royal Society, and took much interest in its proceedings, but deafness, which affected him early in life and increased with age, prevented him from taking an active part in the discussions of the learned societies, or in the debates in the House of Lords, and to a certain extent, therefore, disqualified him

from sharing in, though it in no way diminished the keen interest he felt in their deliberations.

The library in his beautiful and ancient home contained many works on science, literature, and art, but the great storehouse of knowledge was his own brain, and from this he was ever delighted to contribute for the instruction and amusement of his friends. All this, alas, has come to an end; the venerated form will no longer be seen where it was known so well, in the Isle, or in its picturesque surroundings overlooking the sea, but his memory will long be everywhere preserved in grateful recollection by his friends and countrymen. J. F.

RORAIMA

BY the kindness of Sir Joseph Hooker we ar able to give some illustrations relating to Roraima taken by Mr. Im Thurn during his recent successful expedition (aided by funds supplied by the British Association and Royal Geographical Society) to the top of the previously unscaled mountain. The following extracts from the paper read on Monday at the Royal Geographical Society, by Mr. H. J. Perkin, who accompanied Mr. Im Thurn, will give some idea of the work and results of the expedition :—

The 1st of December, our first day in Brazilian territory, we camped to the south-west of, and quite close to Waetipu, a splendid mountain towering above the general level of the table-land some 3000 or 4000 feet, with bold, sharp outlines ending in a well-defined peak, on its south side free from forest, the savannah continuing quite up to its summit, though densely wooded on its north-north-east and north-west.

From a lofty range of hills some 3600 feet high we had a splendid view of Waetipu, Roraima, Kukenam, Marima, and two small mountains near Waetipu, named Hormi and Mucureepa; the curious square, flat tops of Roraima and Kukenam, with their dark, precipitous cliffs, adding a grand and peculiar effect to the whole landscape. On December 2 we arrived at Toroikire or Ipelemonta, an Arecuna village of four houses situated on the left bank of the Arapu river.

The view from here is magnificent, as the village is placed just in front of Roraima, giving a sight also of Kukenam; it is situated on a high hill 3751 feet above sea-level, but is dwarfed by the gigantic walls of rock near it, Roraima being about four, and Kukenam about three miles from it. Each mountain seems like a huge impregnable fortress, built on a mountain-top 7000 feet high, with walls from 1200 to 1800 feet in height.

The portion of Roraima facing Teroota is four miles long, and of Kukenam about the same. In wet weather their summits are wrapped in dark clouds, and after the rain is over and the clouds have dispersed the water can be seen casting itself over the cliffs in splendid falls that only by being seen can be at all imagined. At a distance of four to five miles they look like delicate white threads against the dark background of sandstone rock.

The two mountains are separated by a wide gorge, and in this clouds of dense white mist accumulate, and gradually creeping up as the day advances, enshroud their summits something after the manner of the "table-cloth" of Table Mountain.

The chief difficulty Mr. Im Thurn apprehended was from the dampness of the spot, as he feared he would be unable to dry the sheets of botanical paper used to preserve the specimens of plants he obtained, but by means of a large fire kept burning night and day this was easily accomplished.

Whilst on this first visit of ours to the upper portion of Roraima we saw on the face of the cliff itself a ledge of rock running up from the tree-covered portion of the highest sloping portion of the mountain to its summit; it appeared to us extremely easy to climb, except in two places: the first where the bush that covered the ledge appeared to end suddenly, leaving the cliff bare and naked, and giving the ledge the appearance of being interrupted, and consequently impassable; and in the second place where a waterfall from the summit falls on the ledge and has cut a gap in it, so that there seems to be a deep, wide hole, which it would take great trouble to bridge over. But on the whole it seemed so easy to climb the mountain here that we concluded there must be some insuperable difficulty of which we were not aware, for other travellers who had visited the mountain had stayed near this ledge, though, except Mr. Whitely, none of them attempted it, most of them having had to turn back soon after their arrival, owing to want of provisions, which latter contingency Mr. Im Thurn had particularly guarded against, and enabled us to stay some time and to make several excursions over the mountain-sides.

The north-east and west sides of Roraima are forest-covered, but on the south and south-west it is for the most part devoid of trees until a height of 5890 feet is reached, and from here up to the cliff-face the slope becomes far more steep and is covered by a thick, dense undergrowth: there are very few large trees, and even they are small when compared with the giant vegetation of the forests we had passed through.

Teroota village lies, so to speak, at the foot of the mountain, though the cliff portion is about four miles distant. Between Teroota Hill and Roraima flows the Kukenam river, which rises in Kukenam Mountain and descends from the summit in a splendid fall of about 1300 feet.

From the Kukenam river Roraima on its south-western side slopes up at an angle of about 20° to 4500 feet, and then at 30° to the commencement of the forest-covered portion to 5890 feet; from here to the cliff-face the incline is 15° steeper to about 7200 feet, and the remainder is cliff. At about 5600 feet we found a large piece of swampy ground filled with most exquisite varieties of orchids and ferns, and also the *Utricularia Humboldtii*, which grows to greater perfection here than on the Kaieteur savannah. Here also we found the Heliamphora or pitcher-plant, whose cup-shaped leaves were full of water; it bears a delicate white flower without smell.

We returned the same day, December 5, to Teroota, after our visit to Siedl.

We reascended the mountain on Sunday, December 7, and built our houses, one for ourselves and one for the men, at an altitude of 5405 feet above sea-level, close to Siedl's hut.

On the 10th, with Mr. Siedl, we went up a path cut by a Mr. Whitely in 1883, to the face of the cliff, and on our way, at 6410 feet, found a lovely flowering plant, the *Leiothamnus Elizabethæ*, of Schomburgk; it has deep carmine star-shaped flowers, with a white star centre, the points of which radiate down the petals. At 6841 feet we rediscovered another exquisite flower, first found by Richard Schomburgk, an Utricularia, with a large deep crimson blossom. The plant grows on the branches of trees, and is about 2 to 3 inches in height; the bloom, when but, completely hides the stalk, and is about an inch and a quarter long, by half an inch wide; sometimes there are two flowers on the same plant, but usually only one. The appearance of one of these bright blossoms on the sombre tree-branches has a most peculiar effect, and one's admiration is divided between the brightness of the flower and the wonderful energy of the tiny plant that produces it. Pursuing our way we reached the cliff at 12 o'clock, nearly three hours from the start, the way being extremely rough and steep, over root and trunks of trees, and bare rocks: at times we could hear water running among the stones under our feet.

There are no trees of any very great size growing on

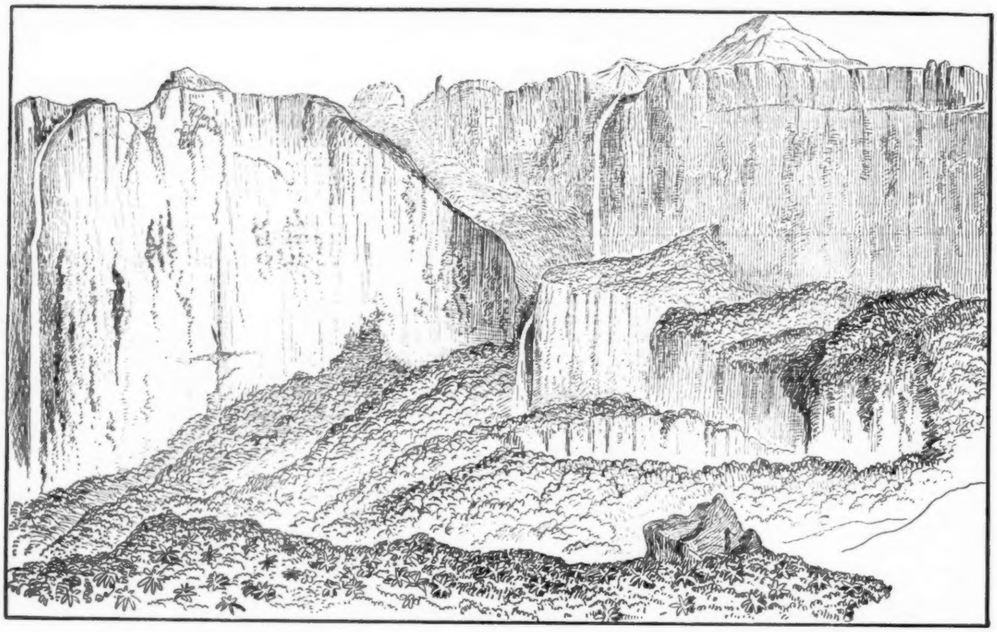

FIG. 1.—Part of south-west face of Roraima, showing ledge by which we ascended.

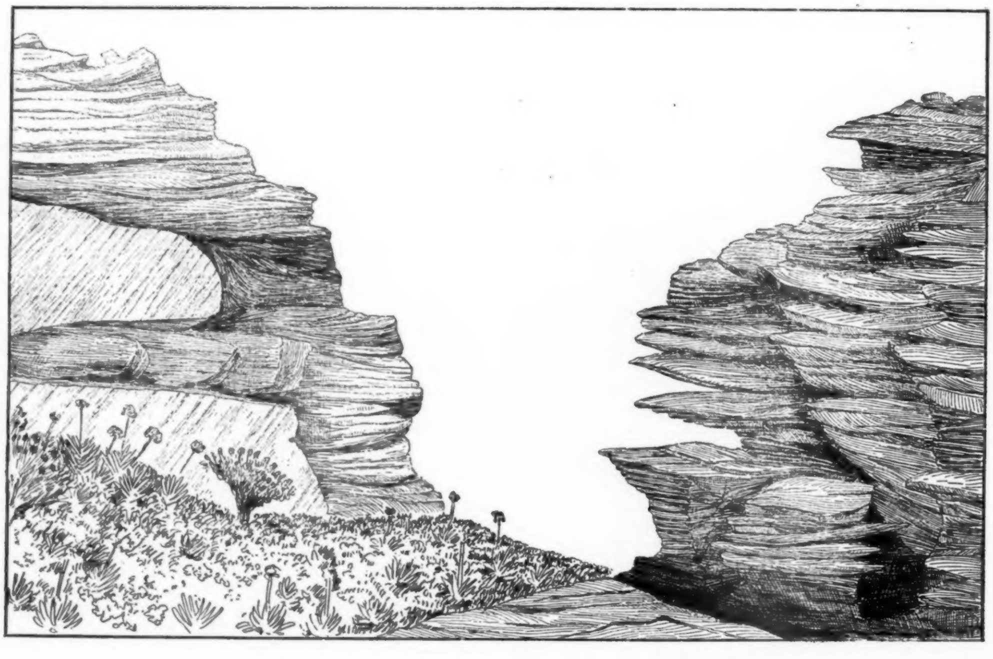

FIG. 2.—Scene at point of entrance on to plateau on top of Roraima.

that portion of the mountain, but the varieties of ferns are very numerous and beautiful, varying from small filmy to tall tree ferns, some 20 to 30 feet in height; but the plant that seemed to awaken for the time as much interest with us as any other, was the *Rubus Schomburgkii*, or Roraima blackberry, which greatly resembles the English bramble; we gathered several bunches of the fruit, which possibly does get sweet, but none of those we obtained were at all eatable.

From the portion of the cliff we reached we had a good view of the ledge we had seen on the 5th, and, though

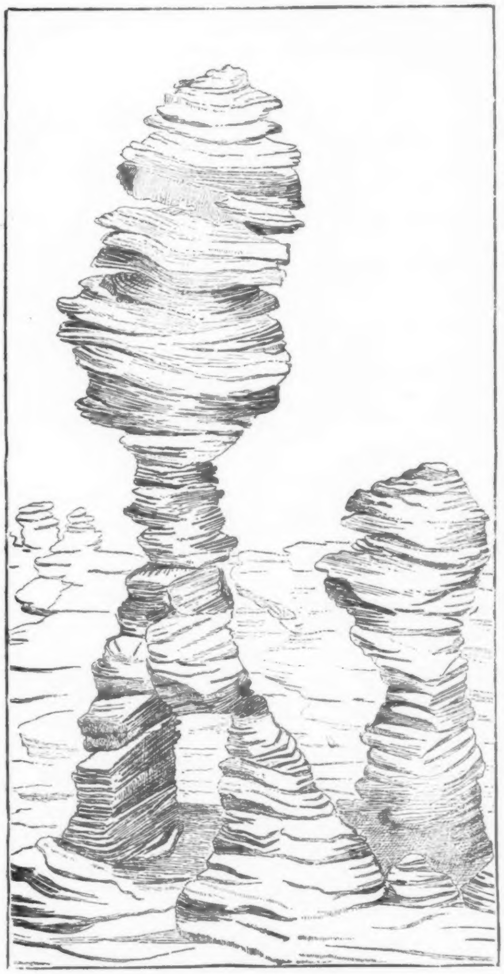

FIG. 3.—Scene on top of Roraima.

partially obscured by the intervening bush, it seemed quite easy of ascent.

The height we reached this day was 7350 feet, determined by boiling-point thermometer, and it took us three and three-quarter hours to return to our hut, a distance of about two and a half miles, as we frequently stopped to collect ferns and other plants on our way.

On the 11th we ordered the Arecunas to cut a path to the foot of the ledge from the edge of the savannah, and if possible to continue it as far as the summit. After a day's work they returned, saying they had finished the road, but we afterwards found they had left off from fear of Makunaima, the great spirit, just at the point where the ledge joins the upper sloping portion of the mountain. This was on the 14th, when we reached 7756 feet above sea-level, and found our way suddenly barred by a precipice of 120 feet. A heavy mist, too, arose, and it became bitterly cold, with the rain falling in torrents, which rendered our return journey dangerous, and the path slippery and muddy.

The next few days were occupied in surveying the country around the mountain and preserving plants; it was still too wet and slippery to enable us to make any further attempt on the mountain, but, learning from Simon, the Arecuna chief of Toroiking, that the rainy season was about setting in, we determined to make use of the first fine morning we might have; and on December 18, which dawned most auspiciously for us, we left our house after an early breakfast at 7 a.m., reaching the cliff at 8.30, where we waited for about half an hour, and then set forward along the ledge, the path keeping much the same the whole way over rocks and roots and trunks of trees, and sometimes along the slippery leaning stems of the trees, using our hands and knees for some portion of the way.

The Arecunas we had with us hung back when we got thus far, and for a long while would not proceed, until, by dint of persuasion and the promise of a taste of ardent spirits, we prevailed on them to accompany us; we had, however, to send one of the men from the Pomeron, a half Negro, half Indian, to go first and lead the way, cutting a path as he went on. In this way we reached the waterfall, which to our great surprise we found extremely easy to pass, as the ledge was not cut away by the action of the water falling on it, and fortunately there was very little water coming over, being more like a very heavy shower, which wet us to the skin immediately. The foothold around the spot was extremely precarious, being worn quite smooth and slippery by the constant moisture and falling water.

From this fall to the top the last portion of the ledge slopes at an angle of 30°, and is in places quite twenty or more yards in width; it is covered by a dense growth of moss, and in spots tall coarse grass, which gives way here and there to flowering plants and small shrubs. Of the flowers one in particular, a species of heath, took our fancy by its dark pink blossoms of six petals, about the size of a halfpenny, which lay in quantities along our path.

So occupied were we in securing each new treasure that we had almost gained the top before being aware of it, for near the summit the ledge loses its steepness and is, so to speak, merged into the top itself.

A curious sight met our eager gaze as we passed the boundary line of the unknown—on all sides were grouped rocks of every shape unimaginable, weird, strange, and fantastic, first a row of huge oblong stones that looked like rude cannon placed there to guard the approach; further on another rock like a giant's umbrella on a short thick stem of about four or five feet in height, and others like miniature castles and ruins of old churches, leaning so much that had they not been solidly connected portions of the enormous sandstone bed, they would have fallen. We saw no lake, however, but several pools of water here and there. The vegetation on the summit was extremely scanty and insignificant. There being no trees, only small bushes from three to six feet in height, growing at long intervals and, with the exception of a few scrubby orchids, two species of thick-leaved ferns and a variety of the red Utricularia from below, there was no other plant there, owing, no doubt, to the absence of soil: for it is not possible for earth to collect on the summit, as it would be almost immediately carried over by the rain-water which finds its way over the edge of the enormous cliff

soon after it has fallen in most splendid waterfalls, some of which have a clear fall of 1500 feet.

We had no sooner accomplished the ascent than an impenetrable cloud of mist enveloped the whole of the upper part of the mountain, entirely obscuring the view, and rendering it difficult to see beyond forty or fifty yards in any one direction, and putting a limit to our wanderings.

After boiling the thermometer, which registered 197° F., the average of five readings, and gave the height (allowing for difference of temperature from sea-level) as 8600 feet, we returned to our hut, but not before I had tried with true British instinct to carve my initials as a memento of our visit; but I found the rock far too hard to permit of this, and had to content myself with leaving an advertisement torn from a newspaper of Messrs. Pears' soap and Madame Patt's testimony of its suitability for the hands and complexion.

In conclusion, I beg to present the Society with a few samples of rock and rounded pebbles, which I obtained in the course of our journey up the mountain. I have been told they lead to no very definite conclusion in a geological sense, as they seem to belong to no particular geological epoch, but are apparently agglomerations of deposits from various causes.

No fossils have been found, but several of these smooth pebbles which I found imbedded in the living rock on the summit point to its having been submerged at some long-passed time, but whether this huge mass has been obtruded by volcanic action, or the cliff has been bared of its at one time circumjacent soil by glacial or aqueous action, I leave for those skilled in geology to discuss, and shall be happy to give any further information that may lead to a more definite conclusion as regards the formation and age of the mountain.

One word more and I have finished: it is to again remind you that the whole success of the expedition is due to Mr. Im Thurn's excellent management and indefatigable zeal, as well as his intimate knowledge of the Indian character; and if my short notes have aroused your interest in Mount Roraima, I must ask you to accord a larger portion of the same to his complete and detailed report, which I have no doubt will ere long arrive.

NOTES

It is well known to all acquainted with the British Museum, that the staff of the Zoological Department is very insufficient for the needs of so large a collection. In the vast subject of entomology especially the number of assistants is quite out of proportion to the mass of material necessarily accumulating with the advance of geographical exploration. We are glad to learn that a step towards remedying this state of things is about to be taken by the addition to the staff of an assistant, to be specially engaged upon the collection of Coleoptera. The conditions upon which the appointment will be filled up are announced in our advertising columns.

There seems to be at last some chance of the great Hume collection being received by the nation, as the British Museum has sent Mr. Bowdler Sharpe to Simla to pack and despatch the collection to England. Mr. Sharpe started by the last mail viâ Brindisi, and expects to be absent from England about four months.

Dr. Benjamin Apthorp Gould is to return to the United States very soon from South America, where he has recently completed the great works upon which he has been engaged for so long at the Observatory of Cordoba. His fellow-citizens of Boston, *Science* states, propose to give him a reception and a dinner on his return.

On May 13 a statue of Linnæus will be publicly unveiled at Stockholm. The day will be the 178th anniversary of his birth.

Reports from Japan state that grave fears were entertained of an outbreak of the long quiescent volcano Fujiyama, and that officials had been sent to investigate the matter. The people living in the neighbourhood believed an eruption to be imminent, because, while the snow on the mountain had begun to melt two months before the usual time, all the wells at the fort became dry, and difficulty was experienced in procuring water. The phenomenon is considered the more remarkable from the fact that the winter has been unusually cold, and that the surface of the snow remains hard, the part nearest the ground being the first to give way.

Intelligence has been received in Amsterdam from Java of the eruption of the Semiroo mountain, the largest and most active of the Javanese volcanoes, situated on the confines of the Passoerean and Probolingo residencies. No mention is made of any loss of life having occurred.

Prof. Forel, of Geneva, has sent us an account of an earthquake observed in Switzerland on April 13 last. It was composed of a preliminary shock at Neufchâtel between 9 and 10 o'clock, of a principal or great shock at 11.23 a.m., and of a succeeding shock observed at Lausanne and Geneva at 3.55 p.m. The principal shock disturbed a considerable area. It was felt in the district bounded by Geneva, Saint-Cergues, the Joux valley, Neufchâtel, Souceboz, Aarau, Schwyz, Interlaken, the Bernese Alps, Bex, and the Lake of Geneva. The detailed reports from the other cantons, Valais in particular, will extend still more the area of disturbance, which already includes a district 220 kilometres long by 100 broad, representing a superficial area of more than 20,000 kilometres. The main axis of disturbed surface is parallel to the chain of the Alps; in seismological classification this earthquake would therefore be put under the classification of longitudinal earthquakes. Over the disturbed area the shock was felt unequally. Thus in the cantons of Vaud and Neuchatel, the district which Prof. Forel is appointed to study, numerous and precise observations were received from Enhaut, Ormonts, the Rhone valley, the shores of the Lake of Geneva, from Villeneuve to Morges, then from Ginguis, Saint-Cergues, l'Orient de l'Orbe, Neufchâtel, Souceboz, &c., while none at all came from the valley of the Broil or of the Thièle, nor from Gros du Vaud. It would seem that the centre of the district remained quiet, while the borders were disturbed. The intensity of the shock was greater as one approached the centre, which was probably the valley of the Haut Simmenthal. There some damage was effected in the walls of houses; it is even said that rocks were detached from hills. This would represent a shock No. 8 in the scale which represents the intensity of earthquakes in ten numbers. In Prof. Forel's district the earthquake had very little intensity. The shock had three undulations, with some seconds' interval between each. In general the direction of the oscillations was indicated as parallel to the meridian, from north to south, or, according to the localities, as coming from north-east or north-west. A subterranean sound was heard in several places.

At the conclusion of an article in a recent number of *Globus* on the Andalusian earthquake, Herr Willkomm refers to previous earthquakes observed in Southern Spain; for, although that of Christmas day last is the greatest and most frightful of them all in the historical period, it is by no means singular in other respects. The provinces of the kingdom of Granada, those of the kingdom of Murcia to the east of the latter, and the province of Alicante belonging to the old kingdom of Valencia, have frequently been visited by earthquakes. At Cape Roquetas

hardly a year passes without one. Judging from past shocks, Granada and the neighbourhood of Torrevieja and Guardamar in the south of Alicante, are the two main earthquake centres. From the last the shocks extend along the coast as far as Malaga. The most violent occurred in 1518 and 1829. On November 9, 1518, the town of Vera in Almeira was wholly destroyed, and in March, 1829, the towns of Guardamar and Torrevieja were converted into heaps of ruins. Malaga has been visited by earthquakes four times during the past century—viz. 1775 and 1777; October 8–10, 1790; January, February, and August, 1804, and August 4, 1841. In 1802, from January 17 to February 6, there were repeated shocks at Torre la Mota and Torrevieja; on July 9, 1822, at Cartagena, Murcia, and Alicante (over 200 shocks in twenty-four hours); on April 27, 1826, and until July of the same year, innumerable shocks in and around Granada. The whole population of Granada left the town and camped in the fields. Similarly for many other places in Southern Spain. If to all these be added the numerous earthquakes on the west of the peninsula, with centre at Lisbon, it will be clear that, next to Italy, no other part of Europe is so frequently visited by earthquakes as the south and west of the Iberian peninsula.

M. CAMBOU, a missionary in Madagascar, writes from Tamatave to *Cosmos* to report that on February 25, after a terrible cyclone, the coast of Madagascar, near Tamatave, was covered with pumice-stone and dust, in all probability, says M. Cambou, from the Krakatoa eruption. On March 28, 1884, similar pumice was found on the coast of Réunion. Subsequently, in the middle of May, the same phenomenon was observed on Mayotte, in the Mozambique Channel; and in September of last year it was noticed at Tamatave. Crystals of feldspath were mixed with the amorphous matter. The stones were generally small, the edges being worn round by attrition. A very few were of a pale reddish colour. According to the course of the currents in the Indian Ocean these would have been carried from the Straits of Sunda down to the 16th or 17th degree of south latitude in a south-westerly direction. Thence they reached Madagascar, and the adjacent islands, through the agency of the equatorial current and the trade-winds. The probability that this pumice is that of the Krakatoa eruption is supported by the following facts: the American frigate *Pensacola*, passing the Straits of Sunda on December 22, 1883, crossed large banks of pumice, and continued to sight smaller ones until January 10, 1884, when she was in 16° 7′ S. lat. and 66° 8′ E. long. The average speed of the current is stated to have been fifteen miles per day. Subsequently, on April 13, 1884, the French war-ship *Boursaint* met a bank of this pumice floating off the coast of Madagascar, in 14° 35′ S. lat., and 48°2′ E. long. The circumstances under which this pumice reached the Malagasy coast are specially interesting to ethnologists, as they afford a new proof of the possibility of human migrations to considerable distances. They also give some support to the theory that the Hovas of Madagascar are of Malay descent.

THE Madrid Correspondent of the *Standard* writes that several doctors in Valencia have been making numerous experiments by inoculating adults and children with the choleraic virus. The faith of the local physicians and of persons of all classes in these experiments is so great that in one afternoon 300 persons were inoculated. The Scolapian Fathers brought all their pupils also for this preventive vaccination against cholera. The medical men say the same phenomena have been observed as were noticed in similar experiments in France last year during the epidemic. A commission of Madrid doctors has been sent to report on the experiments.

THE Executive Council of the forthcoming International Inventions Exhibition at South Kensington has issued a most useful railway-guide and route-book, for the use of intending visitors. The district included is about forty miles in every direction around London, and the book gives for each station the number of trains daily, the fares, the average time occupied on the journey, the points at which to change for connection with the Exhibition, and the last two trains each day. It will be of great use to those numerous visitors who are not acquainted with the readiest and most convenient methods of getting from South Kensington to other parts of the metropolis and its suburbs.

WE have received the second edition of Marion's "Guide to Photography," the first edition of which we noticed on its appearance. The text contains various additions, needed to bring it abreast of the latest photographic improvements.

WE have received the Report of the Mason Science College, Birmingham, for the year ending "Founder's Day," February 23, 1885. The appeal issued last year for an additional endowment fund for scholarships and exhibitions, additions to the teaching staff, &c., has been met by subscriptions amounting to nearly 5000*l*. The free lectures to artisans appear to have been very successful, each lecture having to be repeated on account of the demand for tickets. It is interesting to notice that the chairman of the Academic Board reports that "the presence of ladies in the classes stimulates manly qualities in the students, and encourages gentlemanly behaviour." Besides prizes in all five languages taught, the ladies have distinguished themselves in physics this year. The fees for the evening classes have been diminished by one-half, being now threepence each lecture.

THE National Fish Culture Association have transferred another large consignment of whitefish fry to the lakes in the Isle of Mull in order to further their acclimatisation to the waters of this country. Hitherto many experiments have been tried in this direction, but with no success. The American Government are rendering valuable assistance in effecting their propagation and are watching the result of the endeavours now being made with keen interest.

THERE will shortly appear, published by the Clarendon Press, "The Flora of Oxfordshire," including the contiguous portion of Berkshire, by G. Claridge Druce, F.L.S., &c. Over half a century having elapsed since the publication of Walker's "Flora of Oxfordshire," the many changes in nomenclature, the subdivision of species, and the great advance in botanical knowledge, demand a new work on the subject. Mr. Alfred French long ago commenced one, and on his premature death, in 1879, his MSS. came into Mr. Druce's possession. At the request of the Director of the Botanical Department of the British Museum, he undertook its completion. The "Flora" is intended to be not only a catalogue of the county species, with their localities, but also a history of them, and of the botanists connected with the University and county. About 400 species and varieties, additional to those given in Walker and Sibthorp, will be enumerated, and something like 20,000 records have been made in visiting nearly every parish in the county. The comparative plant occurrences in the counties of Berks, Bucks, Warwick, Northampton, and Gloucestershire will be shown. Orders should be sent to Mr. G. C. Druce, 118, High Street, Oxford.

A "BEGINNERS' Star Atlas," by the Rev. T. E. Espin, with an introduction by Mr. J. A. Westwood Oliver, is in the press, and will be published shortly by Messrs. W. Swan Sonnenschein and Co.

IN a paper read before the Academy of Sciences of Berlin at a recent meeting, Dr. G. Hellmann continued a paper read previously on certain regularities in the states of the weather in successive seasons of the year. The author, from a long series

of observations, draws a conclusion contrary to the current belief —viz. that a mild summer follows a mild winter. He studied the warm summers of Berlin from the year 1719 in one particular aspect—that is to say, with special reference to the succeeding winters. He regards that summer as warm when the temperature in June, July, August, and September, or at least in three of those months, is above the normal. Fifty-two such summers occurred between 1719 and 1885. Unfortunately there were certain gaps in the observations which could not be filled up; but there was no break in the observations between 1755 and the present, in all 130 years of uninterrupted observation. During this period there were 45 warm summers, or a proportion of 1 : 2·89. But, as in the case of mild winters, there was no periodicity of three years. Thus after the hot summer of 1763 there was not another for 12 years, and at the beginning of the present century there were 19 successive years (1799–1817) without a single hot summer. But in the case of the summers, as in that of the winters, a certain grouping is observable. In the 52 warm summers, in 31 cases 2 hot summers followed each other in succession, "so that one may wager 596 to 404 that one hot summer will be succeeded by a second." The influence of a hot summer on the succeeding autumn and winter (October to February) is that of these months 2·82 were too warm. For the individual months, with the exception of November, the probabilities are about equal. Given a summer with July, August, and September hot, and a cold January, a warm December and February may be expected. As a general rule two warm winter months may be expected after a hot summer. But warm summers differ: they do not last the same length of time, they have not the same intensity; and these variations exercise an important influence on the succeeding winter months. The author then discusses the cold winters of Berlin and the respective probabilities of the succeeding months being cold. The results of the whole investigation he sums up in three propositions arranged and stated as follows:—(1) A $\left\{\frac{\text{moderately}}{\text{very}}\right\}$ mild winter will most probably be succeeded by a $\left\{\frac{\text{cool}}{\text{hot}}\right\}$ summer. (2) A $\left\{\frac{\text{moderately}}{\text{very}}\right\}$ hot summer will most probably be succeeded by a $\left\{\frac{\text{moderately mild}}{\text{cold}}\right\}$ winter. (3) A $\left\{\frac{\text{moderately}}{\text{very}}\right\}$ cold winter will most probably be succeeded by a $\left\{\frac{\text{cool}}{\text{cold}}\right\}$ summer.

THE additions to the Zoological Society's Gardens during the past week include a Suricate (*Suricata tetradactyla*) from South Africa, presented by Miss F. M. Savill; two Common Badgers (*Meles taxus*), British, presented by Lord Willoughby de Broke; a Common Marmoset (*Hapale jacchus*) from Brazil, presented by Miss Henderson; a Cereopsis Goose (*Cereopsis novæ-hollandiæ*), a Black Swan (*Cygnus atratus*) from Australia, presented by Mr. F. L. Frodsham; a Mealy Amazon (*Chrysotis farinosa*) from South America, presented by Mr. W. Hodder; two Alligators (*Alligator mississippiensis*) from the Mississippi, presented by Mr. Charles Ridley; an Alligator (*Alligator mississippiensis*) from the Mississippi, presented by Miss Heimlicher; a Red-tailed Amazon (*Chrysotis erythrura*) from Brazil, three Upland Geese (*Bernicla magellanica* ♂ ♂ ♂) from the Falkland Islands, three Wigeons (*Mareca penelope* ♂ ♂ ♂), European, purchased.

OUR ASTRONOMICAL COLUMN

OCCULTATION OF ALDEBARAN ON MAY 15.—The ephemerides do not take cognisance of occultations of the brighter stars, when near to the sun's place, nor indeed, as a rule, of occultations generally which occur whilst the sun is above the horizon of the place to which the calculations are adapted. In the *Monthly Notices* of the Royal Astronomical Society for March 1868, is a note communicated by Mr. R. S. Newall, drawing attention to an occultation of Aldebaran on May 22 in that year, when the star was little more than 8° distant from the sun, and suggesting that observation would be possible with a good equatorial, and, at any rate, would be worth trying, merely as a matter of curiosity. It does not appear from the succeeding numbers of the *Monthly Notices* that the occultation in question was anywhere observed, but on May 15 in the present year one of the same star will take place when its distance from the sun is 14½°, and some observers may be inclined to make an attempt to record the phenomenon. At the Royal Observatory, Greenwich, the star escapes occultation; in the north of England and in Scotland the times for the various observatories are as follow:—

	Disappearance G.M.T. h. m.	Angle °	*Reappearance* G.M.T. h. m.	Angle °
Liverpool	2 50·0	19	3 5·7	353
Stonyhurst	2 47·6	24	3 9·0	348
Glasgow	2 39·6	38	3 10·1	334
Edinburgh	2 37·9	39	3 14·2	334
Dunecht	2 35·3	45	3 16·9	328

At Dublin the star disappears at 2h. 46·2m. G.M.T., and reappears at 3h. 1·0m.; angles 19° and 354° respectively, counted as usual in the *Nautical Almanac*.

VARIABLE STARS.—(1) Dr. Gould, in the *Uranometria Argentina*, enters into some detail with respect to the relative magnitudes of the bright stars in *Corvus*, to the discrepancies in estimating which Argelander first directed attention in vol. vii. of the "Bonn Observations." It was considered that the Cordoba observations "served to remove all doubt as to the variability, within moderate limits, of all four of these stars, thus explaining the apparently contradictory nature of previous observations." On the other hand, Mr. E. F. Sawyer, of Cambridgeport, Mass., says he carefully observed the bright stars of Corvus during the years 1882–84, and found that "β is certainly variable by nearly one magnitude, but that the other stars appear to be sensibly constant," and he thinks the whole difficulty is thus solved. From Dr. Gould's remarks, however, there is room for doubt on this point.

(2) A minimum of R Leonis may be expected about May 26. The observations from 1840 to 1883 afford indications of the existence of a perturbation in the period.

THE DOUBLE-STAR γ EQUULEI.—The duplicity of this star was detected by Mr. G. Knott in 1867; his measures in that year give for 1867·543, position 276°·84, distance 2″·131. For the epoch 1877·728 Mr. Burnham found the position 274°·5, distance 2″·16. The annual proper motion of the principal star appears to be + 0·0027s. in right ascension, and − 0″·169 in declination, and if Mr. Knott's measures of 1867 are reduced to Mr. Burnham's epoch, with these values, they become—

Position 308°·0—Distance 3″·20,

differing so widely from the Chicago results as to be strongly indicative of the binary character of the object.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, MAY 3–9

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on May 3

Sun rises, 4h. 30m.; souths, 11h. 56m. 42·0s.; sets, 19h. 24m.; decl. on meridian, 15° 48′ N.: Sidereal Time at Sunset, 10h. 11m.

Moon (at Last Quarter on May 7) rises, 22h. 32m.*; souths, 3h. 0m.; sets, 7h. 27m.; decl. on meridian, 18° 17′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	4 17	11 25	18 32	12 28 N.
Venus	4 33	11 56	19 19	14 58 N.
Mars	3 59	10 51	17 43	9 27 N.
Jupiter	11 50	19 7	2 24*	13 56 N.
Saturn	6 32	14 39	22 46	22 11 N.

* Indicates that the rising is that of the preceding and the setting that the following day.

Phenomena of Jupiter's Satellites

May	h. m.		May	h. m.	
3 ...	23 35	II. ecl. reap.	7 ...	0 4	I. ecl. reap.
5 ...	2 3	I. occ. disap.		20 12	I. tr. egr.
	23 24	I. tr. ing.	9 ...	1 38	II. tr. ing.
6 ...	1 44	I. tr. egr.		23 56	III. tr. ing.
	20 32	I. occ. disap.			

The Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

Saturn, May 3.—Outer major axis of outer ring = 38″·3; outer minor axis of outer ring = 17″·4; southern surface visible.

May 4, 17h.—Venus in superior conjunction with the Sun.

GEOGRAPHICAL NOTES

THE Austrian African explorers, Prof. Frederick Paulitschke and Dr. Dominik Kammel von Hardegger, have returned from their expedition to Africa. They started from Trieste on December 30, 1884, and chiefly explored the interior of the Gallas country. The Austrian explorers have established meteorological stations at Harrar and Zeila, which will be looked after by the English Consuls Pitten and King. The collections they have brought with them, filling several cases, will constitute a very valuable addition to the Austrian Imperial Museum.

AT the January meeting of the Royal Swedish Geographical Society, Dr. F. Svenonius gave a very interesting account of his visits to certain remote parts of Swedish Lapland last summer. The speaker could not accept the theory set forth by some authorities that the word "Lapp" was derived from the Lappish *loap* or Finnish *lappi*, *i.e.* "end" or "finish," signifying the inhabitants of the end of the European continent. He believed that the word was derived from *lappa* or *lappah*, *i.e.* "cave" or "recess," a name given by the Scandinavians to this race from the habits of the Lapps in earlier times living or taking refuge in caves or recesses. It was a common thing, even now, for Lapps to take refuge in such places in bad weather, or for the night when travelling. Having referred to the remarkable structure which forms the dwelling of the Lapp, he proceeded to describe the mountains, glaciers, lakes, and waterfalls of Swedish Lapland. The mountains were more imposing seen from the Swedish than the Norwegian side, as in the latter place they were too close to the spectator. They were of two kinds, the so-called "alpine" and so-called "grass" mountains. The former were lofty and jagged, and the latter—the most common—low and rounded. The alpine mountains were composed of hornblende, gabbro, and eklogite, and the grass mountains of schist impregnated with chalk. The highest parts of Swedish Lapland were those around the sources of the river Rapaädnos, the highest top of which, Sarjektjåkko, was once believed to be the highest mountain in Sweden, and west of the Lake Pajtasjärvi, where there are two lofty peaks, Kaskasatjåkko and Kebnekaisse. The greatest glaciers in Sweden were found within these parts, the former having been named the "ice-depôt of Lapland." He estimated that about 180 square kilometres, or one-seventh of the whole area, were covered with "eternal" ice, the depth of which reached several hundred feet. It was impossible to say whether the Lapland glaciers were increasing or decreasing. Judging by other European glaciers, they should be decreasing very fast. The fact that the flora of Lapland was actually receding, which pointed in the opposite direction, and seemed to indicate a deterioration of the climate, he believed was due to the circumstance that the Lapland glaciers had an "heirloom from the Glacial Age" still to get rid of. The lakes covered a vast portion of Lapland chiefly between the mountains and the so-called "forest-land." The surface area of the lakes here was one-third of the whole of Swedish Lapland. But there were also many great lakes in the alpine districts. Of the waterfalls the most imposing were the Stora Sjöfall, 130 feet high, and Harsprånget, 70 feet high, and with a volume of water estimated at 500 cubic metres per second. There were besides several beautiful but smaller falls in the Gellivara Lappmark. In conclusion, Prof. von Düben, who has travelled much in Lapland, stated that he believed that the word "Lapp" was derived from the old Finnish word *lappaa*, *i.e.* "roam about," as suggested by a great authority, viz. Prof. Friis, Professor of Lappish at the Christiania University.

GUIDO CORA's *Cosmos* for 1884 (vol. viii.) contains an attractive paper on Tahiti and the natives of Polynesia, recently visited by Dr. Filippo Rho of the Italian Royal Marine, who sailed from Callao for the Pacific waters on board the *Caracciolo* in June, 1883. The "Kanaka," or Polynesian race proper, is described as presenting many points of resemblance to the Malays, from whom the writer supposes them to have originally sprung. But the type can be best studied in Tahiti and the other eastern islands of the Pacific, where it is found in its purest state and least affected by Papuan elements. It is sub-dolichocephalic, with cephalic index 76·2; keel-shaped skull; mesorrhine nose (index 49·3); not prognathous if unmixed, although in Tahiti the facial index is 75·0, and in general conformation not far removed from the white or European type. The nose, sometimes straight, sometimes aquiline, sometimes rather short and flat, is always characterised by wide nostrils. The jaw-bones, though strong, are not prominent; face oval; eyes black, well shaped, never oblique; complexion variable from light brown or copper to olive yellow, but always fairer than that of the Malays; hair black, often coarse, generally straight, but sometimes wavy; beard scant; stature very tall and slim, although a tendency is shown here and there towards obesity. The Tahitians are of a cheerful temperament, passionately fond of song and dance, and some favourable specimens are given of their *himenè*, a term derived from the English word "hymn," a relic of the days of the Protestant missionaries before the French occupation. These *himenè* are chiefly historical, religious, warlike, or amatory, the latter often extremely pathetic, as, for instance, the elegy of the distressed maid, who flies to the woods, crowns herself like Ophelia with flowers, and dies with the name of her faithless lover on her lips. "I turn weeping from side to side of my grassy couch; alas! he is away! we are severed for ever, and I alone keep my love. I stand in the shade of the Tu tree, and wreathe myself in the flowers he loved, to bear the grief of my beloved who has forsaken me. Thou forsakest me, never to return, and I die alone like the bird that finds no branch of any tree whereon to perch." There is an amusing description of Queen Marau's visit to the Italian man-of-war, whose officers were afterwards invited to a banquet, the *menu* of which is given in Tahitian and Italian. It began with roast pork, followed by raw fish *à la taiero* (a kind of pickle made of grated coco, sliced lemons, and salt water kept in a bamboo cane), prawns, salt fish, bananas, taro, a species of mango (*Spondias dulcis*), concluding with a dessert of cocoa-nuts and oranges. A native banquet is thus a sort of *résumé* of the fauna and flora of the Society Islands.

THE *Bollettino* of the Italian Geographical Society for April publishes two interesting letters from the engineer, Count Augusto Salimbeni, who had accompanied the third Bianchi expedition to Gojam, which had such a disastrous termination. These letters, addressed to Sig. Grimaldi, Minister of Agriculture, and to Prof. Tacchini, are dated from Dildil-Jimma, Gojam, December 27, 1884, and January 2, 1885, and describe the commencement of a stone bridge over the River Temcha, the first of the kind in the country since that thrown some two centuries ago across the Abai (Upper Blue Nile) by the Portuguese. This work, so far carried out under great difficulties with the assistance of Giuseppe Andreoni from the Swiss Canton of Ticino, will consist of three arches with a total length of 50 m. and 20 m. above the stream. King Tekla-Haimanot, at whose request it was undertaken, was greatly surprised at the progress already made, and expressed his satisfaction to Count Salimbeni in these terms:—"At first I did not believe you. But it was not altogether my fault. Europeans coming here have talked to me about the splendours of their lands, have brought me handsome presents, but have never shown me any of their works in stone and mortar. Our history relates how the Portuguese, to build the bridge over the Abai, brought down fire from heaven, with which they dammed up the water. It is also said that they required a thousand oxen daily to mix the mortar. But you have asked for nothing but stones, sand, wood, and water. Your work is better than that of the Portuguese. Now I believe you." It was expected that the bridge would be finished in March.

THE same number of the *Bollettino* brings to a conclusion the important and timely paper by L. Paladini on the foundation of European colonies in Africa, and especially in Algeria and Tunis. The object of the writer is to warn Italy against rash enterprises of this sort, nearly all of which have hitherto proved to be financial and even political failures. Speaking more particularly of Algeria, he describes the results, after fifty-four years of occupation, as almost nothing compared with the vas

expenditure of blood and treasure incurred by the French Government. The military expenditure alone, he calculates, at about a yearly average of 3,000,000*l.*, or 162,000,000*l.* to the present time. To this have to be added nearly 4,000,000*l.* for some eighty fortresses and stations of all sorts required to overawe the natives; about 1,800,000*l.* yearly for the civil administration; 8,000,000*l.* for caravanserais to develop the trade of the interior; 6,000,000*l.* for the ports of Bona, Philippeville, Algiers, Bougie, Oran, and one or two others; 8,000,000*l.* or 10,000,000*l.* for arsenals, canals, dredgings, and other hydraulic works, besides many other incidental expenses, the whole far exceeding any profits hitherto realised by the trade of the country. The writer dwells upon the rivalries and heart-burnings that have sprung up between the military and civil sections of the European community, which hate each other almost more intensely than both are detested by the natives. He shows that even agriculture has yielded no returns at all commensurate with the outlay incurred, and concludes that, if not actually insoluble, the problem how to found useful and profitable colonies in Africa will always remain one of the most difficult questions for the statesman and political economist.

THE *Boletin* of the Madrid Geographical Society for February gives a complete list of the recent acquisitions of Spain in West Africa. These comprise the west coast of the Sahara between Cape Bogador (29° 9′ N.) and Cape Blanco (20° 45′ N.), both included; in the gulf of Guinea, the coast-line stretching from the Muni River, forming the northern limit of the French possessions on the Gaboon, northwards to the Rio Campo (0° 43′ to 2° 41′ N.). On the Sahara coast six stations have already been established, and all points giving access to shipping will be permanently occupied. The old treaties with the chiefs on the Rio Benito have also been renewed, with a view to prevent the threatened advance of the French in that direction.

PROF. ESCRICHE, of Quadalajara, recently described, before a conference at Madrid, his project for "geographical parks." The geographical park is a public garden, reproducing on a certain scale, according to its extent, the geographical features of a country. It is a kind of map in relief; the principal towns would be represented by places surrounded by trees, the main ways of communication by winding paths; a succession of hillocks would act for the ranges of mountains, streams of water for the rivers. The clumps of trees within the network of roads would form varied pastures, in which the natural products of each locality would find its place among the flowers, and in the centre, where the towns should be, would be placed small structures, in which would be photographic views of the principal monuments, but especially the most important astronomical, geographical, historical, and artistic information with regard to the town represented.

BEFORE the last meeting of the Verein für Erdkunde, at Halle, Dr. Alfred Hettner described the United States of Columbia, their characteristics, and present condition, based on recent journeys there. After deducting the disputed territory on its borders, Columbia is half as large again as the German Empire. Its main geographical divisions are the isthmus region, the mountainous districts in the west belonging to the Andes system, and the low-lying plains of the Amazon and the Orinoco in the east. To the last belongs the Meta, which is very suitable for navigation, but is little used for that purpose; while the Magdalena, which is navigable for 640 kilometres to the Honda Cataract, belongs to the first division. The forest region, with palms in the lower and tree-ferns in the upper parts, extends up to 2900 m., the snow-line being 4600 m. in height. The Indian population, amongst which the Muysca (Tschibtscha) rank only behind the Incas and Astecs in civilisation, was estimated in the sixteenth century at ten millions, but are said to have been reduced by the Spaniards to one-fiftieth of that number. The whole population now is given at three millions, and, according to the estimates of the Columbians themselves, 10 per cent. of these are whites, 40 Mestizos, 35 Indians, and 15 Negroes. Trade is hampered by the bad condition of the roads. Gold, silver, coffee, and hides are the chief articles of export. Railway construction, like trade, is prevented by natural difficulties and the indolent, unpractical nature of the people.

THE *Mittheilungen* of the Vienna Geographical Society for March (Band xxviii. No. 3) contains papers on the movements of the Dachstein glacier during the period 1840-84, by Dr. Simony; an account of the latest explorations in Eastern Equatorial Africa, by Dr. Le Mounier; and the first part of a paper on the geographical work of the German Lighthouse Department in Hamburg, by Prof. Geleich. At the meeting on March 24 Dr. Lenz read a paper on the German colonies in Eastern Africa and Oceania, which is not printed in the present number.

THE Norwegian Government have decided to dispatch an expedition this summer to Finmarken, in the gunboat *Lougen*, for the purpose of effecting hydrographic researches and soundings along the coast. The cost is estimated at 1000*l.* The Swedish Government grant for this year to various scientific publications amounts to about 700*l.* A sum of 50*l.* has also been contributed towards the expenses of Mr. O. Nordstedt's algological researches in England and Scotland this summer.

FURTHER NOTES ON THE GEOLOGY OF PALESTINE, WITH A CONSIDERATION OF THE JORDAN VALLEY SCHEME[1]

THE subject was divided as follows:—(I.) The Geological Formations of Palestine and Egypt; (II.) The Wady Arabah and the Dead Sea Basin; (III.) The Jordan Valley Canal Scheme.

Since the date of the previous communication in November, 1882, much attention had been directed to the geology and physical structure of Palestine and the adjacent regions, especially Egypt. Besides the discussions in the press relative to the suggested Jordan Valley canal, an important expedition was sent out by the Palestine Exploration Fund during the winter of 1883–84, whilst about the same time Sir J. W. Dawson visited Egypt, Suez, the Lebanon, &c., and gave his results in the *Geological Magazine*. Important information relative to the Libyan Desert has lately been published by Prof. Zittel in the "Palæontographica."

I. (*a*) *Schists, Gneiss, Granite, and Porphyries.*—Dawson describes the relations of the crystalline rocks and Nubian sandstone at the First Cataract (Assouan-Syene). A lower crystalline series, which he refers to the Laurentian, penetrated by dykes of granite and diorite, is covered in almost horizontal beds by a second crystalline series consisting mainly of porphyries permeated by dykes of felsite and basalt. Incidentally it was mentioned that, according to Russegger's map, all the Nile cataracts occur where the river is passing over such crystalline areas, whilst the more tranquil stretches of water belong to the system of his Nubian sandstone. An immense mass of crystalline rocks prevails at the great bend of the Nile which has Abu Hamed for its apex: the axis of this system occurs in the Monassir country, which is the wildest region between Assouan and Khartoum. Dawson thinks that the porphyries of Mount Hor may belong to his second series of rocks, which, in more northern countries, is represented by the Arvonian and Huronian.

(*b*) "*The Nubian Sandstone.*"—This exhaustive division of the rocks between the Crystallines and the Upper Cretaceous may be resolved into three sections of different geological age. The Carboniferous age of the lower sandstone and overlying limestone of Wady Nasb has been known for certain ever since the discoveries of Mr. Holland; but Prof. Hull's party has traced this section up the Arabah, and almost as far as the Dead Sea. The middle division is Cenomanian: it is probably in the main the original Nubian sandstone of Russegger, is widely extended in Egypt, occurs in great force at Petra, and constitutes the cliffs on the east side of the Dead Sea. There remains the Lebanon division of the *soi-disant* Nubian sandstone, and this in all probability is really newer than either of the others, being well up amongst the Cretaceous limestones, and possibly on the horizon of certain lignitiferous beds occurring at Edfou on the Nile.

(*c*) *Cretaceous and Nummulitic Limestones.*—The Cretaceous beds are the most important factors in Syria, whilst in Egypt those of Eocene age are much the thickest. Sir J. W. Dawson gives a section of Jebel Attâkah (partly after Le Vaillant), where the two systems are faulted together. He considers this position on the shores of the Gulf of Suez an important one as presenting an intermediate phase in both systems, thus linking the Syrian to the African types. The Cretaceous beds in Egypt are much less calcareous than in Palestine; an abundance of rock salt, gypsum, and bitumen is noted on certain horizons (Zittel). This last circumstance is noteworthy, for it will be remembered

[1] Abstract of paper read at the meeting of the Geologists' Association, on Friday, March 6, by W. H. Hudleston, M.A., F.R.S., F.G.S., &c

that Dr. Lartet assigns to the celebrated Jebel Usdom, or Salt Mountain of the Dead Sea, a place within the Cretaceous system. But Hull's party have obtained evidence which leads them to believe that Jebel Usdom is not of Cretaceous age, but rather belongs to the marls of the Dead Sea basin. This, in fact, is almost the only point where their conclusions differ materially from those of the French geologist.

Neither in Palestine nor in Egypt is there any sharp line of demarcation between the Chalk and the Tertiary rocks, but the chalky sediments of the older Eocene follow those of the Upper Chalk with hardly any variation in their characters. And yet, according to Zittel, the palæontological boundary between the Chalk and the Eocene is clearly defined, notwithstanding the continuity of marine deposits. That author had never observed either in or above the oldest Nummulitic bed a single characteristic chalk fossil; neither did he ever find a nummulite in the chalk strata.

d. Post-nummulitic Rocks outside the area of the Dead Sea basin.—There is considerable difference of opinion as to the age of the formations that were deposited subsequent to the upheaval of the Cretaceo-nummulitic sea-bed. Those at the Isthmus of Suez are especially interesting. Dawson has named them the "Isthmian deposits," and considers them to be later than the Miocene. They occupy the highest land just north of Ismailia—thin-bedded grey limestones with vermicular holes resting on marls, sands, and clays, mostly destitute of fossils, but with some layers holding fresh-water shells, especially *Ætheria caillaudi*, which is also found in the Chalouf cutting. He concludes that a branch of the Nile discharged hereabouts, not into a marine estuary, but into a lake sometimes salt and sometimes fresh. The greater part of these "Isthmian deposits" resembled those of the terraces of the Dead Sea, presently to be considered. The period of their formation was a continental one, pliocene or post-glacial.

The subject of the recent raised beaches of the Red Sea, &c., and the probable bearing of these upon the question of the route of the Exodus was also discussed.

II. *The Wady Arabah, and the Dead Sea Basin.*—It was pointed out that Prof. Hull, in a lecture given at Dublin two years ago, maintained the River theory in opposition to the Lake basin theory, insisting that such a river flowed southerly from the Lebanon through the gorge of the Arabah into the Red Sea. During the pluvial period, according to this author, the overflow of the Jordanic lake was again through the Arabah in a southward direction. Doubts were thrown upon this hypothesis, since, if the present relative levels were maintained, an overflow would take place through the Pass of Jezreel, at a point only 285 feet above sea-level, leaving the watershed of the Arabah still 375 feet above such a Jordanic lake. These points were again brought out in considering the scheme for a Jordan Valley canal.

An account of the physical and geological structure of the Arabah was given, based chiefly upon Hull's summary, and on the work of the Royal Engineers in the late survey. The longitudinal section, by Major Kitchener and Sergeant-Major Armstrong, is a very fine piece of work, and sets at rest for ever the question of level in the long valley between the Red Sea and the Dead Sea, besides supplying an admirable *coup d'œil* of the eastern flank of one of the most extraordinary valleys in the world. The great Dead Sea fault recognised by Von Buch, Hitchcock, Lartet, and others was proved to pass down the Arabah, clinging to the roots of the eastern mountains. Prof. Hull's party observed it in several places, and two cross-sections are given, showing the sedimentaries faulted against the crystalline rocks. The parallel faults near the base of Mount Hor serve to repeat the phenomena with very curious and picturesque results, as is well illustrated by Prof. Hull in his book, "Mount Seir."

The physical problems connected with these dislocations, and with the undoubted existence of the Dead Sea hollow as an independent lake-basin, dating back from a high antiquity, were partially discussed. The Dead Sea basin is separated from the southward portion of the Arabah by a watershed consisting of hard limestone covered in part by sands and gravels. This has an elevation of 660 feet, and is 45 miles from the head of the Gulf; 29 miles further north the sea-level is again reached. Hence the mass of land, through which the southern section of the Jordan Valley canal would have to be cut, is 74 miles long, with a maximum height of 660 feet, and a probable average of 250 feet.

Further proof was obtained of the independent character of the basin north of the watershed in marl deposits at an elevation of 1400 feet above the present Dead Sea level; these contain species of *Melania* and *Melanopsis* identical with some of those now existing in the fresh portions of the Jordanic basin. Hence there is little doubt that we must carry the successive lakes mentioned by Capt. Conder some stages higher than had been supposed previously. It was noted also, as bearing on this subject, that the old marls of the Jordanic lakes are not so unfossiliferous as M. Lartet would lead us to suppose. Tristram describes one species of *Melania* and two of *Melanopsis* as abundant in a semi-fossil condition in several of these old marl deposits.

Next comes the consideration of a problem which results from the adoption of the independent lake-basin theory—viz. "Since the Dead Sea has no outlet, what has become of the materials that have disappeared?" Seeing that the lateral wadies are, in the main, gorges of erosion, the difficulty is still further enhanced. That there has been some connection in past time between this curious hollow and the volcanic outbursts of the Jaulan, &c., is not improbable; indeed, it has long been suspected that an explanation of the phenomenon might, in part at least, be found in this direction. There is a partially analogous case in the meridional trough with its string of charming lakes, some fresh and some salt, which, Mr. Thompson tells us, extends along the west side of the old East African volcano, Mount Kenia: the fresh-water lake, Baringo, 3200 feet above sea-level, occupies the lowest depression of this great hollow.

III. *The suggested Jordan Valley Canal.*—The remainder of the paper was occupied in considering the northern section, by which the waters of the Mediterranean are to be admitted into the Jordanic basin, so as to convert it into an inland sea. If taken through the Vale of Esdraelon into the valley of the Jâlud (Jezreel), between Little Hermon and the Gilboa range, the length would be about 25 miles, starting from the port of Haifa under Mount Carmel. The height of land is 285 feet, and the mean depth of the cutting to the water-surface would be about 150 feet, without including the depth of the canal itself. The surface of the Vale of Esdraelon consists mainly of Post-Tertiary loams, &c., below which hard limestone, and possibly basalt, would have to be encountered. The alternative of a railway was discussed.

CHINESE INSECT-WHITE WAX

A PARLIAMENTARY paper which has recently been published (China, No. 2, 1885) contains a report of a journey through Central Sze-chu'an, which was made by Mr. Hosie, consular agent at Chung-king, chiefly for the purpose of collecting information on the subject of insect white wax, specimens of the insect wax-trees, and forms of the wax product, at the request of Sir Joseph Hooker. The report describes the country traversed, its trade and trading capabilities, and such information as was attainable on any commercial product of the district; but the portion relating to insect white wax is the most interesting part of the paper.

"Insect tree" is the name given by the Chinese in the extreme west of Sze-chu'an to what is probably the *Ligustrum lucidum* of botanists. The point will doubtless be decided at Kew by the specimens which Mr. Hosie has sent home. It is also called the winter-green or evergreen tree; while in the east of the province it is known as the "crackling flea tree," owing, it is said, to the sputtering of the wood when burned. It is an evergreen, with leaves which spring in pairs from the branches. They are thick, dark green, glossy, ovate, and pointed. In the end of May or beginning of June the tree bears clusters of small white flowers, which give place to small seeds of a dark blue colour. In the month of May, 1883, Mr. Hosie found attached to the bark of the boughs and twigs numerous brown pea-shaped excrescences or galls, in various stages of development. In the earlier stages they looked like minute univalves clinging to the bark. The larger galls were readily detachable, and, when opened, presented either a whitey-brown pulpy mass, or a crowd of minute animals, whose movements were only just perceptible to the naked eye. Last year an opportunity of examining these galls and their contents with some minuteness in the chief wax-producing locality in the province presented itself. They are very brittle, and there was found, on opening them, a swarm of brown creatures, like minute lice, each with six legs and a pair of club *antennæ*, crawling about. The great majority of the galls also contained either a small

white bag or cocoon, containing a chrysalis, whose movements were visible through the thin covering, or a small black beetle. This beetle also has six legs, and is provided with a long proboscis, armed with a pair of pincers. It is called by the Chinese the "buffalo," probably from its ungainly appearance. After a few days it turned out that each chrysalis developed into a black beetle, or "buffalo." If left undisturbed in the broken gall, the beetle will, heedless of the wax insects, which begin to crawl outside and inside the gall, continue to burrow with his proboscis and pincers in the inner lining of the gall, which is apparently his food. The Chinese believe that he eats his minute companions in the gall, or at any rate injures them with the pressure of his heavy body, and galls in which beetles are numerous sell cheaper than others. But careful investigation showed that the beetle does not eat the other insects, and that his purpose within the gall is a more useful one. When a gall is plucked from the insect tree an orifice is disclosed where it was attached to the bark. By this the wax insects escape. But if the gall remained attached to the tree no mode of escape would appear to be provided for them. The beetle provides this mode. With his pincers he gradually bores a hole in the covering of the gall, which is of sufficient size to allow him to escape from his imprisonment, and which allows egress at the same time to the wax insects. When the beetles were removed from the galls some of them made efforts to fly; but at that time their *elytræ* were not sufficiently developed, and they had to content themselves with crawling, a movement which, owing to the long proboscis, they performed very clumsily. Through the orifice thus created by the beetle the insects escape to the branches of the tree, if the gall be not plucked soon enough. When plucked, the galls are carried in headlong flight by bearers who travel through the night for coolness to the market towns, and every endeavour is made to preserve a cool temperature in order that the heat may not force the insects to escape from the galls during the journey.

The wax-tree is usually a stump, varying from three or four to a dozen feet in height, with numerous sprouts or branches rising from the gnarled top of the stem. The leaves spring in pairs from the branches. They are light green, ovate, pointed, serrated, and deciduous. The branches are rarely found more than six feet in length, as those on which the wax is produced are cut from the stems with it. The sprouts of one and two years' growth are too pliant, and it is only in the third year, when they are again sufficiently strong to resist the wind, that wax insects are placed on them. In June some of the trees bear bunches apparently of seeds in small pods, and specimens of these have been sent to Kew.

The wax insects are transferred to these trees about the beginning of May. They are made into small packets of twenty or thirty galls, which are inclosed in a leaf of the wood-oil tree, the edges of which are fastened together with rice-straw. These small packets are then suspended close to the branches under which they hang. A few rough holes are made in the leaf by means of a large needle, so that the insects may find their way through them to the branches. On emerging from the galls the insects creep rapidly up the branches to the leaves, where they remain for thirteen days, until their mouths and limbs are strong. During this period they are said to moult, casting off "a hairy garment," which has grown in this short time. They then descend to the tender branches, on the under sides of which they fix themselves to the bark by their mouths. Gradually the upper surfaces of the branches are also dotted with the insects. They are said not to move from the spots to which they attach themselves. The Chinese idea is that they live on dew, and that the wax perspires from the bodies of the insects. The specimens of the branches encrusted with wax show that the insects construct a series of galleries stretching from the bark to the outer surface of the wax. At an early stage of wax production an insect called by the Chinese the "wax-dog" is developed. Mr. Hosie was unable to obtain a specimen of this insect, but it was described to him as a caterpillar, in size and appearance like a brown bean. His theory (which, he confesses, is unsupported by outside evidence) is that the female of the "buffalo" beetle, already mentioned, deposits eggs on the boughs of the insect tree or the wax tree, as the case may be, and that the "wax-dog" is the offspring of the buffalo. There may possibly be a connection between this caterpillar and the gall containing the wax insects. It is said that during the night and early morning the insects relax their hold of the bark, and that during the heat of the day they again take firm hold of it. The owners of trees are in the habit, during the first month, of belabouring the trees with thick clubs to shake off the "wax-dog," which, they assert, destroys the wax insects. After this period the branches are coated with wax, and the "wax-dog" is consequently unable to reach his prey. The first appearance of wax in the boughs and twigs has been likened to a coating of sulphate of quinine. This gradually becomes thicker, until, after a period of from ninety to a hundred days, the wax in good years has attained a thickness of about a quarter of an inch. When the wax is ready, the branches are lopped off, and as much of the wax as possible is removed by hand. This is placed in an iron pot with water, and the wax, rising to the surface at melting-point, is skimmed off and placed in round moulds, whence it emerges as the white wax of commerce. The wax which cannot be removed by hand is placed with the twigs in a pot with water, and the same process is gone through. This latter is less white and of an inferior quality. But the Chinese, with their usual carefulness that nothing be lost or wasted, take the insects, which have meantime sunk to the bottom of the pot, and, placing them in a bag, squeeze them until they have given up the last drop of the wax. They finish their short, industrious existence by being thrown to the pigs. The market price of the wax is about 1*s*. 6*d*. per pound. It is used chiefly in the manufacture of candles. It melts at 160° F., while tallow melts at about 95°. In Sze-chu'an it is mixed with tallow to give the latter greater consistency, and candles, when made, are dipped in melted white wax to give them a harder sheathing and to prevent the tallow from running over when they are lighted.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The following courses of lectures and practical demonstrations are being given this term:—

Physiology, Elementary, by Prof. Foster; Physiology of Circulation and Respiration, Dr. Gaskell; Central Nervous System, Mr. Langley; Chemical Physiology, Mr. Lea: Preparation Class for 2nd M.B., Mr. Hill.

Elementary Biology, Mr. Sedgwick; Anatomical Characters of the Races of Mankind, Prof. Macalister; Demonstrations on Topographical Anatomy of the Head and Neck, Prof. Macalister.

Morphology and Entomology of Vertebrata, Mr. Sedgwick; Elementary Osteology and Advanced Course on Arthropoda, Mr. Harmer; Morphology of Vertebrata, Mr. Weldon; Development of Limbs of Vertebrata, Mr. Gadow.

Elementary Botany, Prof. Babington; Morphology of Cryptogams, with practical work, Elementary and Advanced Courses, Dr. Vines; Demonstrations in Systematic Botany, Mr. Potter; Morphology of the Flower, Mr. Hicks; Physiology of Plants, with Demonstrations, Mr. F. Darwin.

Geology, Local Stratigraphy, Prof. Hughes; Waves and Tides, Mr. Hill; Principles, Dynamical and Structural, Dr. Roberts; Irregular Accumulations of Doubtful Age and Origin, Mr. Marr; Palæontology, Wm. T. Roberts: Microscopic Petrology, Mr. Harker; Field Lectures, Prof. Hughes; Palæontology of Reptiles and Birds, Mr. Gadow.

Chemistry, General Equilibrium and the Dissipation of Energy, Prof. Liveing; Organic Chemistry, Mr. Main; Elementary Course, Mr. Pattison Muir; Course for Beginners, Mr. Sell; Gas Analysis, Jacksonian Assistant; Elementary Organic Chemistry, Mr. Heycock; Demonstrations, Mr. Sell, Mr. Fenton, Mr. Neville.

Physics: Optics, Prof. Stokes; Prof. Thomson, Kinetic Theory of Gases; Elementary and Advanced Courses, Mr. Shaw and Mr. Glazebrook; Elementary Physics, Mr. Hart; Demonstrations, Mr. Shaw and Mr. Glazebrook.

Mineralogy, Prof. Lewis; Demonstration Courses, Mr. Solly.

Machine Construction, Mr. Lyon; Surveying, Demonstrators of Mechanism.

Advanced Mathematical Lectures open to the University: Waves, Mr. Glazebrook; Elastic Solids, Mr. Macaulay; Solid Geometry, Mr. Ball; Analysis, Dr. Besant; Laplace's and Bessel's Functions, Mr. Pendlebury; Calculus of Variations, Mr. H. M. Taylor; Rigid Dynamics, Mr. Webb.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 16.—"Note on an Experiment by Chladni." By Charles Tomlinson, F.R.S.

Lord Rayleigh, in a memoir "On the Circulation of Air in Kundt's Tubes," &c., remarks (*Phil. Trans.*, 1884, part I, p. I) that "it was discovered by Savart that very fine powder does not collect itself at the nodal lines, as does sand in the production of Chladni's figures, but gathers itself into a cloud, which, after hovering for a time, settles itself over the places of maximum vibration.

In Savart's memoir, "Sur les Vibrations Normales" (*An. de Ch. et de Ph.* for 1827, xxxvi. 187), the author distinctly claims the above-named discovery. At p. 190 he refers to the nodal lines of Chladni, but adds that by mixing with the sand a finer dust, such as lycopodium, "la poussière fine se réunit pour tracer d'autre lignes circulaires que ce physicien n'a pas connues," &c.

Faraday, in his critical examination of Savart's memoir (*Phil. Trans.*, 1831, p. 299) apparently takes it for granted that Savart started with an original observation.

But this interesting discovery, which has been so fruitful in beautiful results, is really due to Chladni. In his "Traité d'Acoustique," Paris, 1809, he remarks, p. 125:—"Si un peu de poussière fine est mêlée au sable, elle pourra mieux servir pour faire voir aussi les centres des vibrations, c'est-à-dire, les endroits où les parties vibrantes font les plus grandes excursions: les molécules les plus petites de la poussière s'accumuleront sur ces endroits."

Chladni is even more explicit in his "Neue Beyträge zur Akustic" (4to, Leipzig, 1817). At p. 7 he recommends "etwas *Pulvis lycopodii*" as the fine dust to be mixed with the sand; and at p. 69 he remarks that when fine dust accumulates on the centres of vibration, it is in heaps more or less round or long, &c., according to the form assumed by the vibrating part.

When Wheatstone reproduced Chladni's figures on square plates (*Phil. Trans.*, 1833, p. 593) he did not notice the remarkable figures produced by mixing a fine powder with the sand. This was the less necessary because Faraday's memoir had been so recently published, and its conclusion was so satisfactory, namely, that when a plate is vibrating, currents are established in the air lying upon the surface of the plate, which pass from the nodal lines towards the centres of maximum vibration, and then, proceeding outwards from the plate to a greater or less distance, return towards the nodal lines.

With the exception of a very few elementary specimens on a small scale, as given by Chladni and Faraday, this class of figures has been neglected by writers on physics. The author then gives directions for the production of these figures when sand and lycopodium, flowers of sulphur, &c., are used, and in a folding sheet twenty-one are represented of plates of various material and form.

April 16.—"On the General Characters of *Cymbulia*." By John D. Macdonald, R.N., M.D., F.R.S.

The Pteropoda being so purely pelagic in their habit places them out of the reach of zoologists in general; and even systematic writers, as in other cases, are often misguided by incorrect figures and descriptions made up probably from scanty or defective data, but which have, nevertheless, been handed down to us with a show of truth.

The author was impressed with the idea that the figures and descriptions of the species of *Cymbulia* extant were not reliable; and having had an opportunity of examining some specimens taken in the Indian Ocean, he found that such was really the case. In the natural position of the animal the toe of the hyaline slipper of *Cymbulia* should be taken as posterior, and the broadly-notched heel as anterior. Both animal and shell are reversed in Mr. Adams's figure of *Cymbulia proboscidea*, but this is, after all, an error of less importance than that in De Blainville's figure, in which, although the shell is represented in its proper position, the animal is reversed. A pair of eyes are also given in a position where ears alone would be possible, while there is no more evidence of the existence of eyes in *Cymbulia* than in any other genus of Pteropods. The notion of a ventral connecting lobe between the fins is a mistake, though these organs are connected above and behind so as to form a broad, continuous plate.

Zoological Society, April 21.—Prof. W. H. Flower, LL.D., V.P.R.S., President, in the chair.—Mr. Sclater exhibited and remarked on a pair of pheasants from Bala Murghab, Northern Afghanistan, belonging to H.R.H. the Prince of Wales.—Mr. G. E. Dobson, F.R.S., exhibited some skulls of *Crocidura aranea*, and pointed out that they possessed supernumerary teeth (premolars) in the upper jaw.—The Secretary exhibited, on behalf of M. George Claraz, an egg of Darwin's Rhea; and read some notes by M. Claraz on the habits and distribution of this Rhea.—Mr. G. A. Boulenger exhibited a specimen of a Brazilian Snake which had partly swallowed an Amphisbænoid Lizard. The lizard had in its turn partly eaten its way out through the body of the snake.—A communication was read from Sir Richard Owen, K.C.B., containing remarks on the structure of the heart in *Ornithorhynchus* and in *Apteryx*.—Mr. Oldfield Thomas read a paper on the characters of the different forms of the *Echidna* of Australia, Tasmania, and New Guinea, all of which he was inclined to refer to one varying species.—Dr. St. George Mivart, F.R.S., read a memoir on the anatomy, classification, and distribution of the Arctoidean Carnivorous Mammals. The author, after briefly noticing the papers of other naturalists who have of late years treated of this subject, described the main facts concerning the anatomy of the various Arctoid genera, especially as regards their osteology and dentition, and gave detailed comparisons of the proportions of the various parts of the skeleton, comparing them with those of the Æluroids and Cynoids.—Dr. F. H. H. Guillemard, F.Z.S., read the second part of his report on the collection of birds made during the voyage of the yacht *Marchesa*. The present paper gave an account of the birds collected in Borneo. It also contained notes on some birds obtained on the island of Cagayan Sulu, on the north-east coast of Borneo.

Royal Microscopical Society, April 8.—The Rev. Dr. Dallinger, F.R.S., President, in the chair.—Mr. Crisp exhibited a model of an old microscope described in an Italian work published in 1686.—Mr. H. G. Madan exhibited and described Bertrand's polarising prism. He also exhibited a modification of Ahren's double-image prism.—Mr. Dowdeswell exhibited some septic microbes from high altitudes, and detailed experiments as to bacterial germs found at various heights, notably upon the Neisen, at an elevation of about 7500 feet.—Mr. A. D. Michael gave a summary of his paper on "New British Oribatidæ." He first called attention to the nymph of *Cepheus bifidatus*, which he had just discovered; the species is very rare, and the immature stages were not known. Last September, at Keswick, Mr. Michael found two or three specimens, and instead of preserving them as examples, determined to try and breed from them. He isolated them, and after some weeks obtained a few eggs, from which he reared four larvæ; these he has carefully watched for six months until they had changed to nymphs and become full grown; he then killed and preserved two specimens of the hitherto unknown nymph, reserving the two others to rear to the imaginal condition. One was lost just before the final change, the other lived. The nymph which was exhibited was a very remarkable and beautiful creature, surrounded with concentric rows of curved serrated spines longer than the body. Mr. Michael then called attention to a new species of *Hypochthonius*, proposed to be called *H. lanatus*. The abdomen is segmented, and the segments are to a certain extent retractile, as in many insects; this enables the creature to erect or lower the long spines attached to the edges of the segments at will.—An interesting new species, to be called *Notaspis serratus*, abundantly provided with long serrated hairs, and a curious nymph of a *Damæus*, to be called *D. tenupes*, which carries its cast dorsal skins in a pyramid on its back, like a pile of dish covers, and has a central projection on each skin, forming a column to support the whole, were also shown and described, besides other new species.—Mr. Crisp called attention to some very interesting experiments by Dr. Nussbaum and Dr. Gruber, on the artificial division of infusoria. Dr. Nussbaum divided an *Oxytricha* into two halves, either longitudinally or transversely, and found the edges at the point of division were soon surrounded with new cilia. Dr. Gruber artificially divided *Stentor cœruleus* with similar results.—Mr. C. H. Kain's letter on the use of balsam of Tolu was read.—Mr. H. Mills's note on the filamentous projections on the margin of the diatom (*Stephanodiscus niagaræ*) was read, and slides in illustration were exhibited.—Mr. G. C. Karop remarked on an examination he had recently made of the saliva in a case of hydrophobia. The specimens presented the following characters.—Epithelium in large masses, most of the cells crowded with micrococci; bacilli of various lengths, and very variable in diameter. A few showed evidence

of spore formation, and were surrounded by a capsule. Micrococci abundant in masses, diplococci and short chaplets. He also exhibited a drawing of the bacilli.—Mr. J. Mayall, jun., exhibited the diamonds belonging to the ruling machine of the late F. A. Nobert, a typical one being shown under the microscope by Mr. Powell. They had been submitted to various diamond experts and workers with conflicting results, but the careful examination made by Mr. L. Fletcher of the British Museum with the goniometer, showed that in nearly every instance the edges were formed by one natural fracture and one polished face.—Mr. Hardy exhibited a colony of Vorticellæ, having the stalks agglutinated in a bundle, and covered with transparent gelatinous matter. It was found erect on leaves in colonies of 50 to 100, and appearing when loose very like large conochilus.—Mr. Cheshire exhibited a remarkable slide showing conductive nerve-threads escaped from the sheath of the ganglionic chain running through the first three segments of the abdomen of *Vespa vulgaris*.

Chemical Society April 16.—Dr. W. H. Perkin, F.R.S., Vice-President, in the chair.—The following papers were read:—A crystalline tricupric sulphate, by W. H. Shenstone.—A modified Bunsen burner, by W. H. Shenstone.—Note on the history of Thionyl Chloride, by C. Schorlemmer, F.R.S.—On the reactions of selenious acid with hydrogen sulphide and of sulphurous acid with hydrogen selenide, by E. Divers and T. Shimidzu.—On a new and simple method of quantitative separation of tellurium and selenium, by E. Divers and M. Shimosé.

PARIS

Academy of Sciences, April 20.—M. Bouley, President, in the chair.—Account of a new process for liquefying oxygen, by M. L. Cailletet. This process, the result of experiments recently conducted in the Physical Laboratory of the Sorbonne, is so simple and of such easy application that it may henceforth be introduced into the ordinary practice of the laboratory, and even repeated at lectures and before public audiences.—On the various hypotheses regarding the true nature of the purple of Cassius, by M. H. Debray.—Remarks on M. Poincaré's theory respecting the influence of the lunar tides on the trade winds, by M. Faye. It is suggested that M. Poincaré should be invited to give wider scope to his studies in this branch of meteorology, with a view to more fully testing the law that he has already deduced from his remarkable observations.—Note on the differences apparently presented by the various regions of the gray cerebral substance known as psycho-motor centres, as regards their different degrees of excitability, by M. Vulpian. The author rejects Pflüger's hitherto generally accepted theory, and, from further experiments carried out on the dog, arrives at totally different results.—Nebulæ discovered and recorded at the Observatory of Marseilles, by M. E. Stephan. The nebulæ observed at this observatory during the years 1883–84 are here arranged in tables showing the order and date of their discovery, right ascension, and mean polar distance for 1885.—Experiments recently made in Holland on an application of the system of large movable tubes of the pumping apparatus constructed at the sluice-gates on the Aubors River, by M. A. de Caligny.—Explorations of the mission sent to report on the recent earthquakes in the south of Spain, by M. Fouquet. Pending the publication of a complete memoir, a summary is here given of the observations made on the scene of the disturbances, with a view to determining their extent, effects, and probable origin.—On the geological constitution of the Serrania de Ronda, which occupies the western section of the region chiefly affected by the earthquake of December 25, 1884, in Andalusia; report by MM. Michel Lévy and J. Bergeron.—On the Secondary and Tertiary formations of Andalusia (provinces of Grenada and Malaga), report by MM. M. Bertrand and W. Kilian.—On the geological constitution of the Sierra Nevada, the Alpujarras, and Sierra de Almijara, report by MM. Ch. Barrois and Alb. Offret.—On the rotation of a heavy body suspended by a point of its axis, by M. Halphen. In this paper the author completes Jacobi's theory that the rotatory movement of a heavy body around a point of its axis may be replaced by the relative movement of two bodies on which no accelerating force is exercised.—On the equilibrium of a liquid mass to which a rotatory movement has been communicated, by M. H. Poincaré.—Application of the empirical formula of mutual forces to the mechanical laws of solids and the general properties of bodies, by M. P. Berthot.—Note on two new indicators for taking the quantitative analysis alkalimetrically of the caustic bases in the presence of the carbonates, by MM. R. Engel and J. Ville.—On the volatile property of the oxygenised nitrites, by M. L. Henry.—On the formation of the alkaloids in pulmonary and other maladies, by M. Villiers.—On the part played by the winds in agriculture, their influence a chief cause of the fertility of Limagne d'Auvergne, by M. Alluard.—Note on the relation between the lunar declination and the mean latitude of the starting-points of the trade-winds, by M. A. Poincaré.—On the anatomical characters of the leaf and on epharmonism in the family of the Vismiæ, by M. J. Vesque.—On the variations in the respiration of plants at the different stages of their development, by MM. G. Bonnier and L. Mangin.—On the origin of the loam of the plateaux of Western Europe, by M. A. de Lapparent.—Note on a new method of defence against mildew in the French vineyards, by M. Minière.

ROME

Reale Accademia dei Lincei, December 14, 1884.—Influence of magnetism on embryogeny. Prof. Maggiorani made a communication to the Academy regarding his own researches on the influence of magnetism on embryogeny, and in one of the last sittings of the last academical session he made a statement as to some of the results at which he had arrived. He explained how the observations had up to that time been made on adult animals developed from magnetised eggs; in his more recent researches Prof. Maggiorani has studied the effect of magnetism on the formation of the embryo. In this case also he found that magnetism has a retarding action on the development of the embryo. In the experiments which he made in conjunction with Dr. Magini eggs that had been subjected to the action of magnets of different powers, and others that had not been so treated, were placed in an incubator. The eggs used were fresh, and every external source of disturbance was avoided. None of the eggs escaped the retarding action of the magnetism, the effect of which was found to be proportional to the strength of the magnet employed and the duration of its action. Greater activity seems to be manifested during the first ten days than during subsequent periods. In the first few days there was likewise observed the curious phenomenon of an exceptional energy in the vital functions of the embryo, an energy which contrasts with the subsequent retardation which the embryo undergoes in its own development. According to Prof. Maggiorani this last fact is a direct consequence of the initial increased energy of the vital processes, that increase of energy injuriously affecting the general nourishment of the embryo. The author concludes by proposing another explanation of the phenomenon, by means of interference, and he adduces some interesting analogies between the so-called vital force and magnetism.—On the fossil ziphioid found in the Pliocene sands of Fangonero near Siena. Signor G. Capellini read a paper on the Ziphioid (*Choneziphius planirostris*) found in the Pliocene sands of Fangonero near Siena. Two portions of the skull of this interesting delphinoid were found at Antwerp in 1809 and 1812, but hitherto no other remains of it had been discovered anywhere. Last year Prof. C. d'Ancona having acquired for the Florentine Museum portions of a skull and some other bones excavated near Siena, Prof. Capellini recognised that the fossil remains belonged to the same species of Ziphioid which had been illustrated by Cuvier in 1823 under the name of *Ziphius planirostris*. The portion of the specimen found at Siena supplies what was wanting in those obtained at Antwerp, and removes all doubt as to the true position of this singular cetacean; and enables us to establish correlations between the Upper Tertiary of Italy and Belgium, the sands of Montpellier, and the crag of England. According to Prof. Capellini, the fossil cetacean discovered near Siena is closely allied to the *Ziphius cavirostris* of the present day, a cosmopolitan species captured on several occasions even in the Mediterranean.—The English sunshine-recorder and the Italian lucimeter applied to agrarian meteorology. Prof. G. Cantoni drew the attention of the members of the Academy to the fact that at the beginning of the year Hirn had brought forward an actinometer of his own invention founded on the principle applied by the Italian Bellani to a small instrument which he reproduced, afterwards devoting himself to finding out a method for making out of it a *lucimeter* capable of being used by agriculturists. Prof. Cantoni has made numerous experiments on the lucimeter of Bellani, comparing its indications with those of the sunshine-recorder. Employing these two instruments together he

ascertained by means of the lucimeter the duration of sunshine at a given place, its intensity with relation to the height of the sun and the clearness of the air; and then by means of the sunshine-recorder the periods during which the sun shone more or less were recorded. The author advises students of vegetable physiology and agriculturists to make use of both instruments.—On the physio-pathology of the supra-renal capsules. Prof. G. Tizzioni has continued his observations on animals from which he had removed the supra-renal capsules. The result of the last experiments shows that those animals which survived the operation suffered no change in health, in nutrition, or development. In those cases in which an abnormal bronze coloration was seen in the lips and the mucous secretions of the mouth and nose, it was ascertalned that this coloration stopped short at a certain point, and only in exceptional cases began to increase again so as to attain vast proportions; but there was observable a diminution, or even entire disappearance, of these pigmental spots. In none of the rabbits experimented on was there any impoverishment of the blood discoverable; the proportion of hæmoglobin appeared to be quite normal. The important fact in this communication of Prof. Tizzioni's consists in this, that the supra-renal capsules may be renewed, and that when that takes place the new capsule arises at a position situated at some distance from that occupied by the old capsule which had been removed. The tissue giving rise to the new organ is that of the sympathetic nervous system, and hence the capsules belong to the nervous system of organic life. We have thus the demonstration not only of the possibility of the reproduction of an entire organ, but also of the nature of that process; and the bases for further investigations as to the functions of the organ are now fixed.—On the Columbite of Craveggia in Valvigezzo. Signor Strüver laid before the meeting the result of his crystallographic investigations of the columbite which he found in some specimens of pegmatite forming an extensive deposit near Craveggia in Valvigezzo (province of Ossola). In these masses of pegmatite Prof. Spezzia had already discovered a new variety of beryl. The columbite investigated by Prof. Strüver is a new mineral, not only for Italy, but even for the whole chain of the Alps. The degree of hardness of its crystals was found to be 6, and under the blowpipe the presence of iron and manganese was revealed.—On sylvic acid. Dr. L. Valente has succeeded in obtaining from colophony (common rosin) a well-determined acid, called sylvic acid. This is the only well characterised acid that has been extracted from colophony since the researches instituted by Lieberman, and the reactions obtained by him by means of a supposed sylvic acid show by the approximate results that he was only operating with a mixture. Dr. Valente intends to continue his researches, the incomplete results of which he presented on this occasion on the ground of his priority. Other communications:—Drs. Ricini and Marino-Zuco reported on the reactions obtained by them by means of nitrites on ferrous salts.—Dr. Mendini reported on the results obtained in studying the action of bromine on pyrotartaric and citicemic imide.

BERLIN

Physiological Society, March 13.—Dr. Goldscheider gave a short sketch of his investigations respecting points of sensation of warmth, coldness and pressure, in connection with the sense of feeling. The doctrine of the specific energies of the nerves, according to which each nerve-fibre was able to conduct only a definite quality of stimulations and sensations, had to encounter, as was known, great difficulties in connection with the sense of smell and the sense of touch, seeing that the number of smells was very manifold, and that, consequently, very many essentially different sensations were taken up and conducted by the primitive fibres of the nerves of smell, while, again, the stimuli acting on the cutaneous nerves were also qualitatively diverse. In the case of the sense of smell the difficulties would perhaps only be resolved when the very various smells were satisfactorily reduced to a few simple fundamental sensations. With respect to the sense of feeling, on the other hand, a sense which comprised the five different qualities of pain, pressure, tickling, warmth, and cold, the latest researches went to show that here in point of fact were different nerve-terminal apparatuses to be distinguished, each endowed with its own specific energy. In examining the sense of temperature in the skin by means of rounded metallic points, the speaker found that there were a very large number of points which were sensitive to cold, and also a number of other points which were sensitive to warmth. These were unequally distributed over the body, and decreased in number and density towards the periphery. They appeared to stand in a certain contrast to the fineness of the sense of touch, being found more rarely where the sense of touch was very delicate. On a more minute study of these points it was shown that they were ranged together in the form of chains, and that there were always several chains of cold or of warm points, as the case might be, radiating from one spot of the skin. These radiating centres lay, in the majority of cases, to the number of about 80 per cent., each at the root of a hair, though all hairs did not cover radiating centres of such chains, while, on the other hand, there were radiating points not situated at the roots of hairs. The chains of cold points, again, never coincided with those of warm points; but these two sets of chains lay adjacent to each other. The cold points were alone capable of generating cold impressions, while all other points of the skin never excited such cold sensations. There were, however, differences among the cold points, inasmuch as some always gave rise to the exclusive feeling of coolness, while others, even under weak stimulations, always produced only an intense feeling of cold. Entirely analogous to this arrangement was the arrangement of the warm points. Some generated the single feeling of lukewarmness, others that of warmth, and others, again, that of severe heat, no matter what the degrees of stimulation in the three different cases. Not only oscillations of temperature, but also mechanical and electrical stimulations, produced the feeling of cold at the cold points, and at the warm points the feeling of warmth. On the other hand, neither at the cold nor at the warm points did the prick of a fine needle cause a painful sensation. The cold and the warm points were anatomically sharply defined, and were constantly found respectively at the same spots of the skin. On further investigation it was, however, ascertained, after taking observations several times of small sections of the skin, that, in consequence of fatigue and habituation due to repeated stimulations, the points very soon ceased to act; but, on being left for a considerable time in repose, they came decisively into operation again at the same spots. The localisation of the sense of temperature was a highly developed one. When one measured the least distance at which two cold impressions were felt distinctly from each other, it was found at spots which contained few cold points to attain a maximum of from 4 to 6 mm., while the minimum was 0·8 mm. Dr. Goldscheider had made minute topographical studies on his own body in respect of the distribution of the points of temperature, and in general he had established that the number of warm points was less than that of cold points, that there were parts of the skin where neither cold nor warm points occurred, and that other parts contained indeed a few cold but no warm points—the glabella, for example. On the other hand, there was no spot on the surface of the body where warm points were found without the presence of cold points. In the outspreading areas of the sensory nerves, especially in those of the facialis, warm and cold points were numerous; but they were sparingly found in the middle lines of the body, as also over the bones. In regard to the theory of the sensations of temperature, Dr. Goldscheider ranged himself on the side of Weber's view, and assumed that a rise of temperature in the skin generated the feeling of warmth—that is, excited the warm points, while a depression of temperature created the feeling of cold, by stimulating the cold points. The experiments on the contrasting effects of temperature were very easily explained by this theory, when it was considered that each stimulation of the cold or warm points blunted them a little, and so rendered them more insensible to the next stimulation. Dr. Goldscheider, after the greater part of his experiments were concluded, received information that, previously to him, Herr Blix had demonstrated the existence of cold and warm points, and their electrical excitability; and, so far as these two independent series of observations covered each other, they completely coincided with each other in their results. After the speaker had thus conclusively established the specific energy of the sense of feeling in respect of the sense of temperature, he applied himself to examine the sense of pressure by means of fine cork points attached to a spiral spring. He found the sense of pressure likewise distributed over the skin in the form of points; and the points of pressure, which coincided neither with the cold nor with the warm points, but occupied altogether special spots of the skin—the sites of special nerve-apparatuses—were also arranged in chain-like rows, these rows likewise radiating from particular points. On the whole, the results in respect

of the pressure points were found to correspond with those in respect of the temperature-points both as regards their distribution and the mode of their specific activity. The localisation of the sensation of pressure was still finer than that of the sense of temperature. The smallest distance at which two neighbouring points of pressure could be recognised as distinct amounted to 0·1 mm. For the sense of pressure, therefore, just as much as for the sense of cold and warmth, the existence of specific nerve terminal apparatuses provided with specific energies was demonstrated. In reference to the sensation of pain, Dr. Goldscheider was of opinion that no special nerves were to be assumed. On the other hand, he thought that between the cold, warm, and pressure-points lay the terminal apparatuses of those nerves of feeling which produced specially the sensations of touch.—Dr. Tichomirow reported first on earlier morphologic investigations he had made into the embryological development of *Bombyx mori*, and brought out specially his observations on the process of segmentation of the Bombyx ovum, on the first development of the heart, and on the occurrence of an inner skeleton in the head of this insect. He then passed to the chemical examination of the ova of the Bombyx, which he had just finished in the chemical division of the Physiological Institute. The weight of the ova was not a constant quantity, 100 ova giving weights ranging from ·02 to ·06 gr. The firm membrane of the ova had hitherto been universally regarded as consisting of chitin. The easy solution, however, of this membrane in solution of potash proved the inaccuracy of this assumption. It consisted, on the contrary, of a peculiar substance distinguishable from chitin, not only by its ready solubility in potash, but also by a perceptible ingredient of sulphur. Chemically, this substance had most relation to keratin, yet it contained less carbon than the latter, and had therefore received a special name, "chorionin." A comparison of the chemical composition of winter ova which had undergone but a partial transformation with the Bombyx ova developed into caterpillars, showed that in the latter the dry weight had suffered a little diminution, and that the high glycogenous contents of the undeveloped eggs had almost entirely disappeared in the process of development, but, on the other hand, that chitin, which was wanting in the ova, was present in perceptible quantities in the caterpillars; while the nitrogenous bases (nucleïn, probably) were also present in greater quantity in the developed ova than in the undeveloped winter ova.

Meteorological Society, April 7.—Prof. Fischer spoke on metallic thermometers, and described the different kinds of thermographs which had been constructed for the measurement of temperatures by the expansion of the metals for meteorological purposes. At first only one metal was used, either in the form of a long pole fastened at one end and bearing a permanent register of temperatures attached to the other free end, or several pieces of metal were joined together in the form of a lever, to increase the thermal expansion. Later on, two or three metals in the form of plates were bound together, and the difference in the expansions of the different metals was employed as a measure of the temperature. Thermographs of this kind, composed of different metals, were still in use, especially in Switzerland. Several years ago Prof. Fischer had instituted an investigation for geodetic purposes into the rate of movement with which metals followed the atmospheric variations of temperature. The experiments were carried out with two metal points of a base instrument, and their temperatures measured with thermo-electric elements. The result of the experiment was that on a rise of atmospheric temperature the temperature of the metal was found to be constantly lower than that of the air, whereas under a fall of atmospheric temperature the temperature of the metal was warmer than that of the air. These differences were all the greater the greater was the variation of temperature, and especially when the change of temperature occurred rapidly. In consequence of these results, Dr. Maurer, of Zurich, had instituted more thorough comparisons between the readings of the metallic and quicksilver thermometers, and had arrived at results not only completely confirming those of the speaker, but further demonstrating that the differences between the registrations of the metallic and mercurial thermometers did not remain the same at all times, thus showing that the former were not to be relied on for meteorological observations.—Dr. Hellmann discussed a proposal for an inquiry into the requirements for correctly ascertaining the rainfall over a particular district or region. In order to determine how close ought to be the network of stations of observation in the lowlying plain of North Germany for the purpose of obtaining an accurate representation of the distribution of rain there, he proposed the erection of twelve rain-gauge stations over an area of about thirty-seven square kilometres, to be provided with similar rain-gauges, at which observations should continue to be taken for a number of years. One year's, and, still better, several years' observations would suffice to show what was the minimum of rain-stations necessary for the plain. The Society adopted the proposal, and empowered the Committee to carry it out.—Prof. Börnstein laid before the Society three barometric curves traced by self-registering barographs at three different points of the town on March 10. All three showed distinctly a fitful rising of the pressure—at the station situated most to the north at 3h. 28m. in the morning, at that situated south-south-east from the previous one at 3h. 40m., and at that to the south-east at 3h. 42m. From these exactly determined points of time and the distances of the three places, which were ascertained with equal precision, Prof. Börnstein calculated the velocity of propagation of the squall-like atmospheric impulse at 4 metres per second, the breadth of the wavefront at about 2900 metres, and the depth of the squall at 962 metres. From this observation it appeared how desirable it was for the study of atmospheric currents to have many barographs set up at stations situated near each other.

[In the report of the Berlin Physical Society, March 20 (NATURE, vol. xxxi. p. 596, line 29, 2nd column), for *sulphates* of iron, read *salts* of iron.]

STOCKHOLM

Academy of Sciences, April 15.—Prof. C. Malmsten communicated the results of some researches by himself on the theory of numbers.—Prof. Edlund gave a demonstration of the incorrectness of the now prevalent theory on unipolar induction.—Prof. Gyldén presented a paper by Herr K. Bohlin on the element of the orbit of the third moon of Saturn (Tethys).—The Secretary presented a paper by Prof. G. Dillner on the inversion of an algebraic integral as the expression for the radix of an algebraic equation, part 2.

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Diary of Societies

LONDON

THURSDAY, APRIL 30.

ROYAL SOCIETY, at 4.30.—Abstract of some Results in Elliptic Functions. Part II.: J. Griffiths.—Further Observations on Enterochlorophyll and Allied Pigments: Dr. C. A. MacMunn.—Note on a Previous Paper: Prof. G. H. Darwin, F.R.S.

ROYAL INSTITUTION, at 3.—Natural Forces and Energies: Prof. Tyndall.

INSTITUTION OF MECHANICAL ENGINEERS, at 3.30.—Description of the Maxim Automatic Machine-Gun: Hiram S. Maxim.—Abstract of Results of Experiments on Riveted Joints, with their Applications to Practical Work: Prof. Alexander B. W. Kennedy (including the latest experiments described in Prof. Kennedy's Report issued to the Members in February).—Description of the Tripierer Spherical Eccentric: M. Louis Poillon.—Description of a Blooming Mill with Balanced Top Roll at the Ebbw Vale Works: Calvert B. Holland.

FRIDAY, MAY 1.

GEOLOGISTS' ASSOCIATION, at 8.—On Wingless Birds, Recent and Fossil, and on Birds as a Class: Dr. Henry Woodward, F.R.S.—On some recently discovered Insecta and Arachnida from Carboniferous and Silurian Rocks: Herbert Goss, F.L.S.

ROYAL INSTITUTION, at 1.30.—Annual Meeting. At 9.—Water Jets and Water Drops: Lord Rayleigh.

SATURDAY, MAY 2.

ROYAL INSTITUTION, at 3.—Fir-trees and their Allies: W. Carruthers.

MONDAY, MAY 4.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Hempel's Method of Gas Analysis: G. H. Beckett.—Real Strength of Aqueous Solutions of Sulphurous Acids: Messrs. Gates and Shearer.

VICTORIA INSTITUTE, at 8.—Natural Selection and Design: Prof. Duns.

SOCIETY OF ARTS, at 8.—Toilet Soaps: Dr. Alder Wright.

ROYAL INSTITUTION, at 5.—General Monthly Meeting.

TUESDAY, MAY 5.

ZOOLOGICAL SOCIETY, at 8.30.—Observations on the Theory of Sexual Dimorphism: Jean Stolzmann.—On Hypertrophy and its Value in Evolution: J. Bland Sutton.—On the Remains of a Gigantic Species of Bird (Gastornis klaasseni) from the Lower Eocene Beds near Croydon: E. T. Newton.

ROYAL INSTITUTION, at 3.—Digestion and Nutrition: Prof. Gamgee.

WEDNESDAY, MAY 6.

SOCIETY OF ARTS, at 8.

THURSDAY, MAY 7.

ROYAL SOCIETY, at 4.30.

LINNEAN SOCIETY, at 8.—Germination of Seeds after long Submersion in Salt Water: Jas. J. White.—Fossil Ferns of the British Basalts: J. Starkie Gardner.

CHEMICAL SOCIETY, at 8.—Ballot for the Election of Fellows (important).—On the Action of the Copper Zinc Couple on Organic Bodies (Part X.): Dr. J. H. Gladstone, F.R.S., and Mr. Tribe.—Researches on the Relation between the Molecular Structure of Carbon Compounds and their Absorption Spectra: Prof. W. N. Hartley, F.R.S.—On some Points in the Composition of Soils; with Results illustrating the Sources of Fertility of Manitoba Prairie Soils: Sir J. B. Lawes, F.R.S., and Prof. J. H. Gilbert, F.R.S.

ROYAL INSTITUTION, at 3.—Natural Forces and Energies: Prof. Tyndall.

UNIVERSITY COLLEGE CHEMICAL AND PHYSICAL SOCIETY at 4.—Induction in Metallic Masses: A. H. Fison, D.Sc.

FRIDAY, MAY 8.

ROYAL ASTRONOMICAL SOCIETY, at 8.

SOCIETY OF ARTS, at 8.—Small-pox in India: Robert Pringle.

ROYAL INSTITUTION, at 9.—On Adaptation to Surroundings as a Factor in Animal Development: W. F. R. Weldon.

SATURDAY, MAY 9.

ROYAL BOTANIC SOCIETY, at 3.45.

ROYAL INSTITUTION, at 3.—Fir-trees and their Allies: W. Carruthers.

PHYSICAL SOCIETY, at 3 (meeting at Bristol).—On Evaporation and Dissociation: Prof. W. Ramsay and Dr. S. Young.—On a Self-recording Stress and Strain Indicator: Prof. H. S. H. Shaw.—On a Model illustrating the Propagation of the Electromagnetic Wave and on a New Curve-Writer: Prof S. P. Thompson, D.Sc.—Note on the so-called Silent Discharge of Ozone Generators: W. A. Shenstone.

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